LOCAL CLIMATE CHANGE PERCEPTION: THE PSYCHOLOGICAL DISTANCE OF CLIMATE CHANGE AMONG FARMERS IN NEW YORK STATE

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ABSTRACT

Climate change has potential to both positively and negatively impact aspects of agriculture throughout New York State. The success of programs aiming to address climate change through both adaptation and mitigation strategies depends upon the support of the target stakeholders. This study aimed to capture the psychological distance of climate change in the minds of New York (NY) farmers while exploring their concern for specific impacts as well as their willingness to pay (WTP) for mitigation. Overall, participating farmers were aware of climate change and tended to view it as a spatially, socially, and temporally proximal phenomenon. Prior experience with flooding was found to be a significant predictor of respondents' psychological distance to climate change, their stated concern for impacts, and their willingness to pay for mitigation. Communication and outreach initiatives can improve their efficacy by considering the attitudes, beliefs, and concerns of the farmers that they target.

BIOGRAPHICAL SKETCH

Trevor Partridge grew up in rural western New York, the eldest son of an artist and an animal science teacher. Trevor attended public school for his primary and secondary schooling, and graduated from Byron Bergen High School in 2008. His free time was occupied by working on a family farm and playing a myriad of varsity sports. Upon graduating high school, Trevor enrolled in Rensselaer Polytechnic Institute to pursue a degree in engineering. However, his degree path was promptly switched to Geology after taking his first introductory class. After graduating with his B.S. in 2012, and with little desire to pursue a career in the energy sector, Trevor held a series of odd jobs including making snow for a prominent east coast ski resort, milking cows on the South Island of New Zealand, landscaping residential properties, and working as an environmental consultant for LaBella Associates in Rochester NY. In the fall of 2014, Trevor enrolled in an M.S. program at Cornell University to work on a project investigating how farming communities across New York were coping extreme weather events. During this work, Trevor became interested in how individual people are being impacted by climate change and how this influences their attitudes and beliefs. Trevor plans to pursue a doctoral degree in Earth Science Department at Dartmouth College. He hopes to work on projects developing solutions to substantive issues surrounding climate change adaptation and mitigation. In his free time, he enjoys hiking, camping, and learning about the natural world through first hand experiences.

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INTRODUCTION AND THEORETICAL BACKGROUND

Agriculture in a changing climate

Agriculture is inherently dependent upon temperature, precipitation, and solar radiation. Climate change will fundamentally alter global temperature and precipitation patterns, and will undoubtedly impact agricultural systems (and consequently, communities dependent upon them) across the globe. However, the impacts will not be distributed evenly. While certain regions will suffer from impacts associated with warmer temperatures and changing precipitation patterns, other regions could potentially benefit. Broadly speaking, increased warming could beneficially impact agriculture in temperate latitudes as the length of the growing season increases, arable land expands, and yields increase (Schmidhuber & Tubiello, 2007). For instance, the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (2007) projects, with fairly high confidence, that moderate climate change over the first few decades of the 21st century could increase yields for rain-fed agriculture by 5-20% for parts of North America. These potential benefits however need to be offset by increases in the frequency of extreme events such as prolonged heat waves, drought, and flooding. Contrarily, most projections predict drier regions to experience decreased soil moisture and increased evapotranspiration, potentially increasing the amount of arid land and decreasing agricultural yields (Schmidhuber & Tubiello, 2007). For example, most agricultural systems throughout Latin and South America are projected to suffer from increased temperatures and shifting hydrologic cycles resulting in shorter growing seasons and reduced yields (Baethgen, 1997; Mendelsohn & Dinar, 1999). Overall, climate change has the potential to both positively and negatively impact agriculture through shifts in the biophysical, ecological, and economic structures that support modern agricultural practices.

Responding to Climate Change in New York State (ClimAID) (2011), is a report published by New York State (NYS) assessing the impacts of climate change specific to statewide economic, environmental, and public health sectors. Chapter 7, which focuses specifically on agriculture, indicates that the agricultural sector is likely to experience a number of climate-related stressors stemming primarily from increases in temperature and changing precipitation patterns. As is the case globally, climate change impacts in NYS have the potential to both positively and negatively affect agriculture. Warmer temperatures throughout the year will likely result in longer growing seasons, which may be beneficial to farmers. However, increases in temperature will also lead to increased heat stress for crops and livestock as well as shifts in habitable zones leading to increased pressure from pests. It is also projected that New York State will experience shifts in the precipitation patterns. Although these projections are inherently less certain than the temperature projections, it is well supported that less precipitation will fall as snow throughout the state. Changes in the snow cover will result in changes in regional hydrology, water availability, and spring flooding. A decreased snow cover will also likely affect soil temperature as the snow acts as an insulator during the winter months. Although NYS is not as vulnerable to drought as other regions in the U.S., the impacts of flooding have already been observed across the state; these include increased nutrient run off, direct flooding of crops, and delayed access to fields (Wolfe et al., 2011).

While one of the most vulnerable sectors to climate change, agriculture also significantly contributes to the concentrations of greenhouse gases (GHGs) in earth's atmosphere. The IPCC Fourth Assessment Report (2007) states that agriculture, behind fossil fuel use and land use, is one of the main drivers of the increased GHG concentrations. It is estimated that global agriculture (which includes forestry and other land use) is responsible for nearly one quarter of

total GHG emissions. For comparison, the transportation sector is estimated to contribute roughly 14% of global GHG emissions (IPCC, 2014). A report by the Food and Agriculture Organization (FAO) states that global agricultural emissions have doubled over the last 50 years and could increase an additional 30% by the year 2050 if significant steps are not taken (Tubiello et al., 2014). As such, significant mitigation opportunities exist within the agricultural sector.

As with climatic impacts, GHG emissions from agriculture vary significantly by region. Globally, 44% of the total agricultural related emissions occurred in Asia in 2011, while another 25% occurred in North and South America (Tubiello et al., 2014). The most recent U.S. Climate Action Report (2014) indicates that agriculture contributes only 9% of the total U.S. GHG emissions (transportation constitutes approximately 26% of U.S. GHG emissions). A statewide assessment of emissions indicates that agriculture in New York State contributes only about 5% of the 2010 statewide emissions (NYCAC, 2010). While some of these differences result from different accounting methodologies, it is also reflective that different types of agriculture have different emission patterns and certain agricultural practices can either increase or decrease overall emissions.

The coming century poses an unprecedented global challenge of feeding a population of nearly 10 billion people (the projected global population by 2100). Climate change exacerbates this challenge by fundamentally altering the biophysical systems that agriculture is dependent upon (Schmidhuber & Tubiello, 2007). However, agricultural systems have the ability to both adapt to climate impacts and contribute to mitigation efforts, and initiatives targeting both of these areas are on the rise (Howden et al., 2007). The cumulative effects of climate change on agriculture will ultimately depend on localized responses to climatic stressors. Adaptive actions such as investing in infrastructure to protect against extreme weather events, altering planting

patterns and practices in response to yield fluctuations, and developing new resilient crop varieties could reduce the effects of climate change while also increasing the resilience of agricultural systems. Furthermore, many farmers have the ability to significantly contribute to mitigation efforts through adopting new practices or investing in green technology. Effective mitigation has the potential to reduce the effects of climate change not only for agriculture, but for the global community. The success of both adaptation and mitigation initiatives is dependent upon public support, which stems from their perceptions of climate change and the inherent risks associated with it (Howe, Mildenberger, Marlon, & Leiserowitz, 2015). Therefore, understanding farmers' climate change perceptions is an important component of developing effective climate-resilient agricultural programs.

Climate Change Perception

Why is perception important? While the physical manifestations of climate change are just beginning to become apparent (IPCC, 2014), the underlying processes have been understood, at least by the scientific community, for quite some time. The greenhouse effect of carbon dioxide was quantified as early as 1896 by Svante Arrhenius. Arrhenius, a Swedish chemist, estimated that if the level of atmospheric carbon dioxide doubled, the annual mean global temperature would increase by several degrees (Arrhenius, 1896). However, his estimation gathered little public attention or concern. Some, including Arrhenius himself, theorized of the potential benefits of slightly warmer temperatures. During the twentieth century, the understanding of the processes governing our earth's atmosphere grew and the scientific consensus regarding the reality of anthropogenic climate change began to become clear. However, the notion of climate change remained within the bounds of scientific discourse and seldom entered the political or public sectors until the last few decades of the twentieth century.

Today, most estimates suggest that 97 percent or more of *actively publishing* scientists agree that not only is climate change happening, but that the warming trends experienced over the last century are most likely due to human induced forces (Bray & von Storch, 2016; Cook et al., 2013; Doran & Zimmerman, 2009). Given that the scientific community is essentially unanimous regarding the reality of climate change, why is it beneficial to understand the public's perception on the climate change issue?

The public's support is a critical component of the socio-political framework that policy makers utilize to make decisions and implement effective programs (Leiserowitz, 2006). Individuals' willingness to support a particular program is influenced strongly by their perception of the phenomena that the program targets. In order to curb greenhouse gas emissions below levels that are necessary to prevent future catastrophic warming, the public needs to realize that anthropogenic warming is a reality and recognize that future warming may bring unacceptable consequences (Hansen, Makiko, & Ruedy, 2012).

Effectively addressing the climate change challenge will require a global cooperation through the formation and interaction of national, international, and local initiatives. The success of these initiatives will require the support from the involved public at each respective scale (Howe et al., 2015). That is to say, a municipality- wide initiative targeting mitigation or energy conservation will require both the support and buy in from citizens within that municipality. Similarly, programs intended to help farmers adapt to climate change would be ineffective if the farmers targeted don't recognize the risk and take advantage of what the program offers. Furthermore, there is considerable variability in climate change perceptions across the U.S. Public opinion of climate change in the U.S. can vary greatly by scales as small as individual counties (Howe et al., 2015). This variance can lead to a diverse range of political environments

and emphasizes the importance of regional, state, and national agencies understanding the beliefs, attitudes, and perceptions of their relative constituents.

While the scientific perspective is shaped by theory and observation, public perspective can be influenced by emotions, psychology, ideology, personal experience, and culture (Leiserowitz, 2006; Weber, 2010, 2013). Leiserowitz (2006) shows, through a nationally representative survey, that Americans' risk perception is strongly influenced by affective and emotional factors; specifically, an individual's holistic negative affect surrounding global warming is a better predictor of their global warming risk perception than their values or socio-demographics. However, their willingness to support specific policies related to climate change is strongly influenced by values (e.g. egalitarian vs. individualistic). Weber (2010) notes that climate change is inherently difficult to detect through personal experience. Because climate change is inherently difficult to comprehend, individuals' understanding of the phenomena is much more prone to error. That said, some studies have found a relationship between personal experience and climate change perceptions. In a study of British citizens, Spence, Poortinga, Butler, & Pidgeon , (2011) show that individuals who have experienced flooding are more likely to be concerned about climate change, view it as more certain, and are more confident that their individual actions will have an effect on climate change. The relationship between individuals' experience with extreme weather and their perceptions regarding climate change is discussed in more detail in a subsequent section. However, it is important to first discuss some of the inherent characteristics of climate change that make it particularly challenging to understand.

What makes climate change different? While environmental issues have plagued societies for centuries, climate change is inherently different for a few reasons. Specifically, the physical drivers of climate change are largely invisible to human perception, the impacts of

climate change are both spatially and temporally distant (to most Americans), and the indications of a changing climate are hard to detect (Weber & Stern, 2011). These three reasons, described in more detail below, not only make climate change notoriously difficult for the public to perceive and comprehend, but also add an additional challenge to developing and implementing effective policy.

As mentioned, the forces that drive climate change, the accumulation of gasses in the atmosphere, are invisible and largely imperceptible to human cognition (O'Neill & Hulme, 2009). Without scientific instruments we would be essentially unaware of the buildup of carbon dioxide and other GHGs in earth's atmosphere. This inherent intangibility not only makes it difficult for people to conceptualize the process itself, but also to comprehend the potential for risk (Whitmarsh, 2009). Consequently, individuals' beliefs and opinions about climate change are often value laden and subjective (Leviston, Price, & Bishop, 2014). Furthermore, the buildup of GHG in the atmosphere is a cumulative process that happens over long periods of time (in reference to human perception) and it is only the aggregate effect of a populations' GHG emissions that ultimately becomes significant. As such, it is exceedingly difficult, if not impossible, to comprehend the impact that each individual's emissions have on the climate system as a whole. The discrepancy in scale between the individual and the climate can lead to feelings of helplessness and limited self-efficacy (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007). Furthermore, the vast majority of GHGs have exceedingly long residence times. That is, once released, they stay in the atmosphere for potentially hundreds of years (in the case of carbon dioxide and nitrous oxide) before either breaking down or being removed by plants, soils, or the ocean. While the benefit of emitting GHG's into the atmosphere is instantaneously realized (through the production of energy, transportation, etc.), the consequences of doing so

may not be apparent for decades and potentially only impact a far off region. Additionally, the immediate reduction in the emissions of GHGs, although necessary, will not quickly reduce the amount of GHGs currently in the atmosphere. Atmospheric residence times are difficult to comprehend even among educated people. A study by Sterman & Sweeney (2007) found that even highly educated people (who had *not* studied atmospheric science) routinely underestimated the degree to which carbon dioxide emissions must be reduced to stabilize atmospheric concentrations. This temporal and spatial discounting further compounds the difficulty of comprehending the impacts of an individual's emissions as well as the emissions of an entire population.

In addition to the inherent imperceptibility of the drivers of climate change, the climate itself is naturally variable. Earth's climate exhibits substantial climate variability that can be explained through natural causes on time scales ranging from yearly, to decadal, to even longer. For example, the El Niño Southern Oscillation cycle is an irregular variation in ocean temperature and winds in the Pacific Ocean that can impact much of the earth's climate. While individuals can perceive the daily weather, and likely even be cognizant of year-to-year variability, the climate is something more abstract than that. Typically, the climate is defined as a statistical construct of the weather of a region for a prolonged period of time (e.g. 30 years). James Hansen, a prominent climatologist, states the issue clearly: "How can a person discern long-term climate change, given the notorious variability of local weather and climate from day to day and year to year" (Hansen et al., 2012 p. 2415). While it may be tempting to attribute specific deviations from 'normal weather' or individual extreme events to climate change, in reality it is very difficult to draw causation between the two. Furthermore, thinking about climate

change in terms of singular events can lead to an underestimate of the threat that climate change as a whole poses (Weber & Stern, 2011).

Climate change perception in the United States. Three sources were used to assess Americans' perceptions of climate change: a nationwide report published by the Yale Project on Climate Change Communication and George Mason University's Center for Climate Change Communication (Leiserowitz et al., 2013), a series of annual Gallup polls on the environment, and a poll conducted by the National Surveys on Energy and the Environment (NSEE) (2015). All three sources report that the majority of Americans believe that climate change is happening. Leiserowitz et al. (2013) found that roughly two thirds (63%) of Americans believe that global warming is happening, while approximately one quarter (23%) of Americans did not. The 2015 NSEE poll reported an even larger majority, 70%, of Americans believe that there is solid evidence for global warming (Rabe, 2015), the highest percentage since 2008. Gallup, which has been polling Americans about global warming for over the 15 years found in its most recent poll (March 2016) that 59% of Americans believe that the effects of global warming have already begun – also the highest since 2008. Additionally, the Gallup poll found that only 10% of people polled believe that the effects from global warming will never become apparent.

Although all three sources suggest that the majority of Americans accept the reality of global warming, there is still some discrepancy about whether or not human activity is responsible. Leiserowitz et al. (2013) found that less than half (47%) of Americans believe that if global warming is happening, it is caused by anthropogenic forces, a 7% decrease from a 2012 poll asking the same question. Additionally, over a third of Americans (37%) attributed global warming to "natural changes in the environment". The 2014 Gallup environmental poll found a similar trend regarding climate change attribution. While 57% of Americans believed that human

activity is to blame for global warming, 40% still attributed it to natural causes. Both of these percentages are slightly below historic Gallup data, which shows that during the years of 2001 - 2007, 61% of Americans believed that human activity was to blame for global warming and only 33% attributed it to natural causes.

There is also evidence suggesting the American public is significantly concerned about global warming. Leiserowitz et al. (2013) found that 53% of Americans said they were either "very worried" (15%) or "somewhat worried" (38%) about global warming. Additionally, Gallup data shows 64% of people stating they worry about global warming either a "great deal" or "fair amount" in 2016. When asked about the consequences of global warming, significant portions of Americans believe that global warming is currently harming people within the U.S. (34%) as well as throughout the rest of the world (39%). When asked about future impacts, more than half of the American public believed that global warming would harm future generations in the U.S., other industrialized nations, and developing countries (Leiserowitz et al., 2013). Gallup data shows that currently, more Americans "disagree" (57%) than "agree" (41%) that climate change will pose a serious threat to their way of life.

Overall, Americans seem to be quite skeptical of our ability to effectively tackle global warming. Leiserowitz et al. (2013) found that only 5% of people believe that humans have the potential to curb the effects of global warming and will do so effectively. This is mostly attributed to stubbornness, as 25% of Americans state the reason we won't be able to successfully reduce global warming is that people are unwilling to change their behavior. A 2013 Gallup poll found that 56% of people believed that it is possible to take action that would slow the effects of global warming, but does not ask about their perceived efficacy of said action. In

2015 Gallup data shows that 48% of people believe that the U.S. government is not doing enough to protect the environment.

Farmers' perception of climate change. Farmers present an intriguing population for studying climate change perspectives. Although most individuals are likely aware of the weather, many farmers' livelihoods are intimately tied to existing climatic patterns, making them arguably more conscious to changes in weather over extended periods of time. For example, while a prolonged drought may be a nuisance for homeowners and recreational gardeners, it could be economically devastating for a farmer without irrigation capacity. Understanding the dynamics of perception is important for communication and outreach. For instance, farmers that view climate change as an ongoing natural process might not be receptive to mitigation initiatives as they don't recognize the importance of decreasing GHG emissions, but if they notice the effects of climate change, they may be receptive to adaptation initiatives (especially if those initiatives can improve their farming operation).

Relatively few climate change perception studies have focused specifically on farmers. This section will first examine the results from a few studies of farmers conducted in different regions of the U.S., and then discuss the perceptions of climate change of farmers from other developed countries (Australia, Scotland, and New Zealand). The largest U.S. farmer perception study to date surveyed 4778 Midwestern farmers (Arbuckle et al., 2013). The study found that the majority of farmers surveyed (66%) believed climate change to be occurring, but only 8% believed it to be caused primarily by anthropogenic forcing. The same study found that farmers who believed climate change to be occurring and attributable to human activity were more concerned about the potential impacts and much more likely to support mitigation efforts. Farmers who believed climate change to be a natural process were far less likely to support

actions to increase adaptation or mitigation capacities and were less concerned about the potential impacts (Arbuckle et al., 2013). Another study, focusing on farmers in Indiana, found significant differences between the opinions of farmers surveyed and those of the general public. The majority of farmers surveyed (79%) believed that climate change is an 'ongoing natural process', however when asked separately if human activity was contributing to climate change, 45% agreed that it was. Interestingly, nearly one third of farmers (31%) surveyed either did not know or had not made up their minds about the causes of climate change, suggesting that many farmers may require a better understanding of the impacts associated with a changing climate (Gramig, Barnard, & Prokopy, 2013). A similar pattern was observed in a study investigating the perceptions of farmers and ranchers in Nevada. While 60% of farmers and ranchers surveyed agreed that the climate is changing, only 29% believed that it was attributable to humans (Smith, Liu, Safi, & Chief, 2014). Of farmers in California's Yolo County, slightly more than half (54%) agreed that climate is changing and that those changes pose threats to global agriculture (53%). However, when asked more specific questions, agreement tended to decrease. Only 38% of Yolo County farmers agreed that temperatures would increase in the future and only 35% of them agreed that human activity is responsible for climate change (Haden, Niles, Lubell, Perlman, & Jackson, 2012). Additionally, Yolo County farmers tended to view climate change as a relatively distant threat and felt confident in their ability to adapt (Niles, Lubell, & Haden, 2013).

A study of Southeastern U.S. extension educators was conducted to examine the perspectives of this unique sub group within the population of agricultural professionals. As extension educators are often highly trained in their particular scientific field, it may be reasonable to expect them to be more concerned about climate change as a whole. However, Adams, Monroe, Plate, & Wojcik (2011) found that extension professionals in the Southeast tend

to follow a national pattern of climate change perception outlined by Leiserowitz, Maibach, & Roser-renouf (2009). Interestingly, agricultural extension professionals tend to be more doubtful and dismissive of climate change than natural resource extension professionals (Adams et al., 2011).

A recent paper compared results from the aforementioned U.S. farmer perception studies with studies from Australia, New Zealand, and Scotland (Prokopy et al., 2015). The majority of famers in each country believed that climate change was occurring, with Australia having the highest level of agreement (68%). However, it should be noted that farmers in Scotland were not asked directly about their beliefs in climate change, but were asked if climate change was an important environmental issue; 58% of farmers surveyed said that it was. Interestingly, the same study found that less than half of the farmers surveyed believed that the temperature would increase in the future – one of the more certain projections of climate change – and that the vast majority of farmers surveyed had no intention of adopting practices to reduce their emissions (Barnes & Toma, 2012). Contrarily, nearly all of the farmers surveyed in Australia (80%) were interested in transitioning toward sustainable agricultural practices (Hogan, Berry, Ng, & Bode, 2011). Similar to the patterns in the U.S., there exists some disagreement regarding the causation of climate change. Australia was the only country where the majority of farmers attributed climate change to human activity. The reason for this could potentially be that Australia has faced significant climate-related threats, such as severe drought, in recent years. The study in Scotland phrased the question in a slightly different manner and asked specifically if dairy farming contributes to climate change. While only 25% of farmers stated that it does (by far the lowest out of the four countries), this low number could be attributed to that fact that people likely aren't eager to implicate themselves (Barnes & Toma, 2012).

Interestingly, high levels of belief in climate change did not translate to high levels of perceived risk for farmers. Scottish dairy farmers appear to be the most concerned about climate change risks as 45% of them agreed that "climate change will increase productivity losses due to disease and pests" (Barnes & Toma, 2012, as read in Prokopy et al., 2015, p. 500). In the Midwestern U.S., only 22% of farmers surveyed believe that their farms would be negatively impacted by climate change, even though nearly two thirds of farmers believed it to be happening (Arbuckle, Morton, & Hobbs, 2013). One explanation, at least in the U.S., for this discrepancy could be that crop insurance programs buffer many farmers from the risks associated with extreme weather events and climate change (Olmstead & Kleinschhmit, 2008). However, as previously mentioned, people may tend to spatially and temporally discount the risks associated with climate change (Spence, Poortinga, & Pidgeon, 2012).

These studies provide important insight regarding farmers' perspectives toward climate change, for both framing climate communication and developing future climate initiatives, the success of which will require the support of the stakeholders involved (Akter, Bennett, & Ward, 2012). To date, there has not been a stakeholder perception study conducted within New York State. A recent project conducted by Perry & Partridge (2015) investigated how agricultural communities throughout the state were responding to and preparing for severe weather events. Although results from the project have not been published, focus group transcripts seem to follow similar patterns to other regional studies. Data suggest that farmers are experienced in dealing with severe weather, and while NYS was subject to a series of severe weather events in recent years, farms and agricultural communities banded together to successfully respond to weather-related challenges. Interestingly, some farmers did express concern for climate change and the effects it would have on agriculture. One apple producer in western NY stated the

following: "*we're pretty sure climate change [is] coming and how are we going to adjust our operations to meet those challenges I guess it's going to be a big thing [when] the whole climate zone shifts north, should I be going up and buying some land in Ontario to grow fruit?"* The sentiment reflected in this quote diverges from the typical temporal and spatial discounting described in other climate change perception studies (Niles et al., 2013; Spence et al., 2012) and suggests a need for appropriate planning when adapting to the effects of climate change. Examining climate change perception through the lens of spatial and temporal discounting is described in the following section.

Psychological distance of climate change. Psychological distance is a construct that refers to the extent to which an object, concept, or event is removed from one's self. Although psychological distance could refer to the actual physical distance between an object and an individual, it also encompasses temporal, social, and hypothetical distance – or how likely an event / concept / object is assumed to exist (Trope & Liberman, 2010a). Research from the relationship between Construal Level Theory (CLT) and psychological distance (Trope & Liberman, 2010a) suggests that there are diverging construals as an individual's perception moves from psychologically proximate to psychologically distant levels. That is to say, people tend to think of psychologically proximal objects in concrete, low level terms such as specific details relevant to the object. However, when considering objects that are psychologically distant from an individual, that individual will tend to think more abstractly. When thinking abstractly, people are looking at the 'bigger picture'; imagining it in a way that captures its main theme or function, instead of focusing on specific details of the object. Contrarily, when thinking in concrete terms (about proximal objects) people tend to focus on specific details which may not be as important to the overall 'bigger picture.' An example of this may be someone thinking

about planning a vacation a year in advance compared to weeks or days before they are scheduled to leave. When temporally distant, the person will be likely be thinking at higher level (more abstract) construals about the overall intention of the trip, such as the enjoyment and pleasure they will receive from escaping their daily routine. However, as the trip becomes temporally (psychologically) close, their thoughts will turn to specific details; when do I need to leave for the flight? Where will I stay my first night? What food do I need to bring? etc. In relation to climate change, the climate itself is indeed a relatively abstract term or high level construal, while the reflection of infrared radiation by carbon dioxide (and other GHG) molecules would be a low level, specific, description of the same system.

It is theorized that the construal level at which individuals view climate change may have behavioral or attitudinal implications. For example, if climate change is perceived through a low level construal (psychologically proximal), individuals may think about it in more concrete terms, which may increase their desire to take action through either adaptation or mitigation measures. However, if people think of climate change through a higher level construal (psychologically distant), individuals may think about it in more abstract terms. Considering the 'big picture' of climate change could impede action if people perceive it as less tangible or threatening, a stance reflected in many of the farmer perception studies previously mentioned. While this seems to suggest that framing climate change in psychologically proximal lens may increase awareness and encourage action, studies have suggested this isn't necessarily the case (Brügger, Dessai, Devine-Wright, Morton, & Pidgeon, 2015). While presenting climate change in a more proximal framework can have the intended positive effects, it can also have no effect, or even have a negative effect on promoting climate action.

As mentioned, CLT suggests that psychological distance can be divided into discrete underlying dimensions. The four dimensions most commonly included when analyzing psychological distance of a construal are: hypothetical distance, temporal distance, spatial distance, and social distance. Few previous studies have examined climate change perception through the lens of psychological distance. However, it is clear from polling data that people in the U.S. tend to view climate change as temporally and spatially distant phenomenon. Typically, responses indicate people perceive climate change as a threat to distant places and future generations (Leiserowitz et al., 2013). Multiple studies have also suggested that people tend to disproportionately rate personal risk from climate change lower than societal risk (Leiserowitz et al., 2013). The relationship between climate change and each of the four dimensions of psychological distance is described in the following sections.

Hypothetical Distance. Individuals' hypothetical distance to climate change refers the perceived certainty that climate change is real. McDonald, Chai, & Newell (2015) point out that due to the relative complexity of climate change, hypothetical distance can reflect either perceptions about whether climate change is actually occurring or perceptions about the extent to which climate change will have a significant impact (given that it is occurring). Many studies and polls indicate that people are overall fairly certain that climate change is happening (Leiserowitz et al., 2013; Rabe, 2015; Spence et al., 2012), however there is often uncertainty about the extent to which the problem is exaggerated, what specific impacts may be, and whether human activity is responsible or not.

Temporal Distance. An individual may believe the climate is changing, and even that human activity is the driving force, but still not perceive the effects of climate change to be temporally significant. They may perceive climate change as a phenomenon that will occur at

some distant time, possibly outside of their lifetime, potentially leading to express little concern about its reality. Previous studies have found mixed results on how individuals temporally perceive the impacts related to climate change. Leiserowitz (2005) found that even though a majority of the American public was aware of climate change, most people believed severe impacts from climate change won't become apparent until after 2050. Spence et al. (2012) asked a similar question in the United Kingdom and found that 41% of respondents believed that they were already feeling the effects of climate change, with less than 5% of respondents expecting the effects of climate change to be more than 50 years away. These two studies occurred nine years apart in different countries (Leiserowitz (2005) was based on a 2003 survey) and phrased the questions differently, which explains some of the differences between them. However, McDonald and colleagues (2015) suggest that a potential reason for this discrepancy could be that temporal distance to climate change is moderated by the severity of the impacts being considered. People tend to perceive severe impacts of climate change (catastrophic sea level rise, melting of ice sheets, etc.) as temporally distant as they are unfamiliar compared to less severe effects - warmer temperatures, increased precipitation, etc.

Spatial Distance. Spatial distance to climate change refers to the extent to which people perceive climate change impacting geographically proximal versus distant regions. People could accept that climate change is happening, and could perceive that the effects are already being realized, but still may view it as an event that will mostly affect distant places. A large international study found that people tend to be 'spatially optimistic' when it comes to environmental issues. That is, they tend to perceive environmental conditions as worse in geographically distant areas than in their own regions (Gifford et al., 2009). Similarly, Spence et al. (2012), found that even though people tended to perceive the impacts of climate change as

being spatially close, they still perceived distant areas as being more seriously impacted. Indeed, there is reason to expect that distant areas (when referring to the U.S.) will be disproportionately affected by climate change, however another underlying explanation could be that when presented with potentially threatening information, people tend to focus on the aspect of that information that does not pose an immediate threat to themselves (Brügger et al., 2015).

Social Distance. Social distance to climate change refers to how people perceive climate change impacting people similar to themselves (e.g. culturally, professionally, ethnically, or by socioeconomic variables). An individual that views climate change as socially proximate would hypothetically recognize the potential for climate change to have an immediate effect on their life or the lives of people similar to them. Spence et al. (2012) show that the people in their study tended to view climate change as socially proximate, i.e. respondents believed that people like themselves will be affected by climate change. McDonald and colleagues (2015) note that social distance can often be confounded with spatial distance as distant locations tend to be socially (culturally) different as well.

Effect of flooding on climate change perception. As mentioned, what is often referred to as the *climate* is really a statistical construct of a region's weather for a determined amount of time. As such, attributing a single event to climate change is slightly misleading. Furthermore, the relationship between experience and perception, as they relate to climate change is complex and varies significantly between studies (Akerlof, Maibach, Fitzgerald, Cedeno, & Neuman, 2013; Brügger et al., 2015; Spence et al., 2011). As mentioned, the scale and complexity of climate change make it different from most other environmental threats. To make informed opinions regarding the state of the climate, data from a wide range of geographic positions across a broad range of time needs to be considered and interpreted. The experience of one individual

over a short amount of time (or even a human lifetime) is inconsistent with the scales on which the climate actually functions (Newell & Pitman, 2010). However, even with this inconsistency between individual experience and climatic processes, multiple studies have shown significant relationships between experiencing particular weather events and individual's perception of climate change. Spence et al. (2011) found that individuals in the United Kingdom who had experienced flooding expressed greater concern regarding climate change, were more certain about its existence, and felt a greater sense of efficacy in their actions. Joireman, Barnes Truelove, & Duell (2010) show that people's beliefs about climate change and willingness to take action are influenced by the outside temperature. Respondents tended to score higher on a global warming index during warmer periods (62° -82° F) than during cooler periods (30° -61° F).

These studies all suggest that experiencing weather events reflective of (although not attributable to) climate change tend to increase awareness and potentially decrease psychological distance. As pointed out by McDonald and colleagues (2015), this is bittersweet. On one hand, these studies suggest that climate concern and willingness to take action will increase as the inevitable impacts of climate change begin to become realized around the world. However, many experts agree that in order to prevent significant climatic consequences, the time to act is now.

New York Farmers and Climate Change

New York climate action. New York State has begun to address the challenges associated with climate change. In 2009 Governor David A. Patterson signed Executive Order 24 with the stated goal to reduce GHG in New York State to 80% below the levels emitted in 1990 by the year 2050. The executive order also created the New York Climate Action Council (CAC) consisting of 15 state agencies tasked with meeting the stated goals of Executive Order 24 and

preparing a climate action plan. Since 2009, New York State has continued to take a stance on climate change with the creation of a number of other organizations and programs with the intention of climate mitigation[1]. Although some of these programs have proven relatively successful, reaching an 80% reduction below 1990 emissions levels by 2050 is still a long way off.

New York farmer perception study. Agriculture is a key component of New York State's economy and culture. In 2007, approximately 36,000 individual farms covered nearly one quarter of the state's land area, employed over 100,000 people, and contributed $4.4 billion to the state's economy (Dinapoli & Bleiwas, 2010). As previously discussed, climate change brings new and unique challenges and opportunities to individual farmers and the broader agricultural communities across NYS. However, there is potential to address these challenges and capitalize on opportunities through both adaptation and mitigation initiatives to increase agricultural resilience and decrease future climate impacts. The success of any program is driven by the perception and willingness of the people involved (Howe et al., 2015). The need for climate change action is well recognized among many statewide (and local) government agencies as well as the scientific community. The state has set an ambitious target to cut overall GHG emissions drastically by 2050. NYS farmers could significantly contribute to reaching this goal through adopting mitigation practices. Additionally, multiple organizations across NYS have developed programs intended to improve NY farmers' resilience to climate change – the Cornell Institute for Climate Change and Agriculture (CICCA) has recently developed a Climate Smart Farming program and in 2015, Governor Andrew Cuomo announced a grant program targeting *Climate*

[1] Some examples of current New York climate change initiatives include: NY Regional Greenhouse Gas Initiative (RGGI), a market based program to reduce GHG emissions; NYDEC Climate Smart Communities Program, a network of communities engaged in reducing GHG emissions and building climate resiliency; PlaNYC, a New York City effort to address the cities long term challenges.

Resilient Farming. Understanding the immediate concerns, perceptions, and attitudes of NY farmers in regard to climate change will help strengthen current programs while improving future outreach and communication.

To date, no study has examined farmers' psychological distance to climate change. As agriculture is inherently dependent upon weather patterns, farmers offer a unique perspective to study climate change perceptions. Additionally, there has yet to be a climate change perception study conducted on agricultural stakeholders in NYS. This study aims to explore the climate change perceptions of NY farmers, assess their concern for specific climate impacts, and examine their willingness to pay for mitigation policy. A conceptual map of this study is shown in Figure 1. Independent and dependent variables are represented as blue rectangles and their operationalizations are shown in brown ovals. Black arrows represent the relationships being explored in this study. Broadly, this study will: examine how psychological distance to climate change, climate impact concern, and WTP for a mitigation policy vary with individuals' demographics as well as their prior flood experience and assess the relationship between psychological distance, climate impact concern, and WTP among participating NY farmers. The specific research questions this study aims to address are outlined below, while constructs and measures are described in the subsequent section.

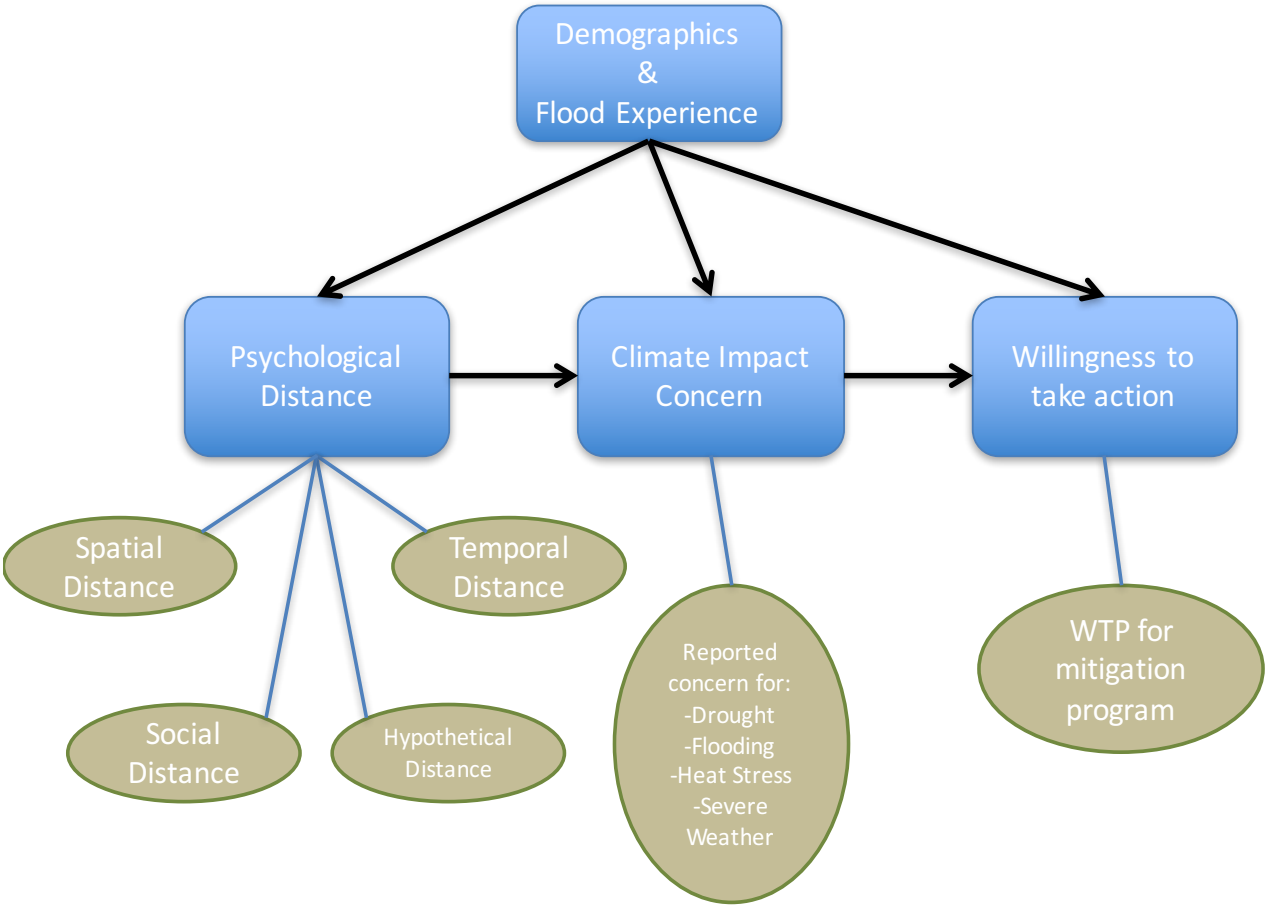

Figure 1: Conceptual map of study. Note that this study did not explore mediation effects between variables.

Research Questions

The following research questions will be addressed:

1. (A) How psychologically distant is climate change in the minds of NY farmers? (B) Do demographic variables predict psychological distance?
2. (A) What level of concern do New York farmers express for certain projected climatic impacts? (B) Is previous exposure to a projected impact (e.g. drought) associated with respondents' reported level of concern for that event in the future?
3. (A) How much are New York farmers willing to pay (WTP) for a climate change mitigation program? (B) Do demographic variables predict WTP for climate mitigation?
4. (A) For New York farmers, what are the relationships among the four dimensions of psychological distance (i.e. social, temporal, spatial, and hypothetical)? (B) How do the dimensions of psychological distance relate to climate impact concern? (C) How do the dimensions of psychological distance relate to WTP for climate mitigation?
5. (A) How is previous exposure to flooding related to farmers' psychological distance to climate change and their (B) WTP for a mitigation program?

METHOD

This cross sectional study aims to examine multiple constructs revolving around an overarching theme of climate change perception among New York farmers through the distribution of a survey. The location and procedure, participant demographics, constructs and their corresponding measures, and data analysis plan are described in detail below.

Setting and Procedure

Surveys were distributed at Empire Farm Days, an agricultural trade show held in central New York State, in August 2015. Empire Farm Days, which is advertised as "the largest agricultural trade show in the Northeastern United States" by its website, is held annually outside of Seneca Falls, New York for three days each August. The trade show features a wide array of agricultural machinery, equipment, live demonstrations, and educational opportunities, and attracts a large crowd of farmers, agricultural suppliers, and extension specialists from a broad range of backgrounds and concentrations. Surveys were distributed through two distribution points on opposing sides of the event grounds. The Northeast Organic Farmers Association of New York (NOFA-NY) and the Cornell Institute for Climate Change and Agriculture (CICCA) both agreed to act as distribution points for the study. Both of these exhibitions were located in either a tent or building amidst various other agricultural exhibits.

Participants were recruited through convenience sampling at both the NOFA-NY and CICCA exhibitions. In an attempt to incentivize participation, individuals who completed the survey were entered into a raffle for one of two $50 gift certificates to Tractor Supply, an agricultural supply store. As people walked by or stopped at the exhibits, they were asked if they would be willing to complete a 10-minute survey about climate change in New York State. If they agreed, a survey was handed to them with a cover sheet explaining the scope and intention

of the project along with necessary contact information and affiliations. Although there was an incentive for completing the survey, that fact was not originally advertised. Signs advertising the study and the incentive were created for the second and third days of the event in an attempt to encourage participation. The survey itself, was self-administered and completely anonymous. Upon completion of the survey, respondents were asked to write their phone number on a raffle ticket for a drawing that occurred at the end of the event. The survey was initially created in Qualtrics, a digital data collection software, with the intention of distributing it electronically via Microsoft Surface tablets. However, the computer tablets were abandoned following technical and user experience issues after the first day for paper surveys (a copy of the final survey is included in Appendix A). Internet connectivity at the distribution sites proved to be inadequate, and multiple respondents were either unfamiliar or uncomfortable with using computer tablets. Results from the surveys completed on the tablets were automatically uploaded to a data set. Results from the paper surveys were manually entered into a Microsoft Excel spreadsheet and combined with the existing data set.

Participants

There were 110 participants in this study. The total number of people approached to participate in the study was not recorded, however the majority of people asked declined to participate. As summarized in Table 1, of the 110 participants who completed the survey, 53% of them were male, 40% had received at least a bachelor's degree, and 44% of them were above the age of 54. Table 2 summarizes the range of farms that respondents were affiliated with. The most common farming commodity was dairy (39 respondents), followed by vegetables (23 respondents), and beef cattle (18 respondents). Twenty-four respondents listed their farm commodity as 'other', when asked these responses included: vineyard, turf, hay, eggs, maple

syrup, sheep, and hogs. Furthermore, 61% of respondents described themselves as the owner of the farming operation, while 24% chose 'None of the above'. When asked to clarify, the most common reason for choosing this option was that the participant had retired from farming. 39% of respondents stated that their farm had been in operation for 50 years, and 50% of respondents listed their operation as 'small' (8% selected 'large', 28% selected medium, and 14% selected 'hobby'). The mean household income for the participants was $69,574 however 34 participants chose not to state their household income.

Table 1: Individual respondent demographics. N=110

Characteristic		%	Characteristic		%
Gender	Male	53.0	**Education**	No high school	9.4
	Female	47.0		High school	14.6
				Some college	19.8
Age	< 25	15.5		Associates	15.6
	25-34	9.3		Bachelors	26.0
	35-44	14.4		Graduate	14.6
	45-54	16.5			
	55-64	29.9	**Income**	mean	$69,574
	65-74	11.3		median	$45,000
	> 75	3.1			

Table 2: Respondents' farm characteristics. N=110

Characteristic		%	Characteristic		Count
Relation	Owner	60.8	**Commodity**	Dairy	39
	FT Employee	4.1		Poultry	13
	PT Employee	5.2		Grain	16
	Spouse	5.2		Orchard	5
	NA	24.7		Beef	18
				Organic	13
Farm Age	< 5 years	12.6		Vegetables	23
	5-10	10.3		Other	24
	11-20	10.3			
	21- 50	27.6	**Farm Size**	Hobby	14.4%
	> 50 years	39.1		Small	50.0%
				Medium	27.8%
				Large	7.8%

To compare participants' demographics with the broader NYS agricultural sector, census data was acquired through The National Agriculture Statistics Service (NASS). In 2012, New York State had approximately 36,000 farms that contributed $4.7 billion in products. The five leading commodities (by market value) were dairy (47.3% total), corn grain (9.8%), corn silage (6.7%), hay (5.6%), and apples (5.0%). The average farm in NYS consisted of approximately 200 acres – about half the size of the national average, and the average net income per farm was around $34,000. Of agricultural operators in NY; the average age is 57.1, 29,078 are men (~ 80%), and 6,459 are women. Furthermore, farming is the primary occupation for only about 60% of primary agricultural operators in NYS (Vilsack, 2012). Information regarding educational attainment and average farm age among NY farmers was unavailable.

Constructs and Measures

All variables were measured through a self-report survey with constrained response options. Independent variables include: demographics such as farmers' age, educational background, agricultural commodity, age of farming operation, and income as well as previous flood experience and exposure to impacts associated with climate change such as heat stress, drought, severe weather, increased regulations, and increased energy costs. Dependent variables are: respondents' psychological distance to climate change, level of concern for specific projected climatic impacts, and individuals' willingness to pay for a climate mitigation policy. When assessing willingness to pay and concern for projected climate impacts, psychological distance is treated as an independent variable in addition to the previously mentioned independent variables. The variables and their operationalizations are described in more detail below and are summarized in Table 3.

Demographics. Demographic variables regarding the individual respondent and the farm with which they are affiliated were collected at the end of the survey. Questions captured respondents' age, gender, education level, relationship to the farm, and income. The type, age, and size of farm were also captured in the demographics section.

Flood experience. Flood experience was operationalized through a single question asking respondents if they have personally experienced flooding in the last five years. Response options were constrained to "Yes", "No", or "I don't know".

Exposure to climate impacts. Exposure to climate impacts was operationalized through asking respondents about their experience with six potential physical and institutional impacts associated with climate change, specifically, "longer dry periods and drought", "increased heat stress", "more frequent or extreme weather events", "increases ponding water and flooding", "increased emission guidelines", and "higher fuel and energy prices". Response options for all six impacts were constrained to "Yes", "No", or "Don't know".

Psychological distance. Psychological distance to climate change was assessed through a measure borrowed from Spence, Poortinga, and Pidgeon (2012). The measure was used in a study exploring the dimensions of psychological distance as they relate to climate change, and the relationship between psychological distance to climate change and sustainable behavioral intentions. Psychological distance is examined through ten items divided between four sub-constructs that relate to the four dimensions of psychological distance described under construal level theory (Trope & Liberman, 2010b): social distance (2 items), temporal distance (1 item), spatial distance (2 items), and hypothetical distance (5 items). Each of these dimensions describes a different aspect of psychological distance, however, existing theory and previous studies suggest commonality between them (Spence et al., 2012). As such, with the exception of

one item from the hypothetical distance scale (discussed below), a measure for psychological distance was created by combining the items from the four sub-constructs. Both the original study conducted by Spence et al. (2012), and the NY farmer perception study indicate a relatively high level of internal consistency (Cronbach $\alpha = 0.74$ and 0.76 respectively) for this scale. However, as noted by Spence et al. (2012) psychological distance is likely not uni-dimensional and the evaluation of each of the aforementioned dimensions is a critical component of fully understanding the variance of psychological distance. The operationalization of each of these dimensions, which are treated as sub constructs, is described below.

Social distance. Social distance to climate change was assessed through two items measuring hypothesized dimensions of respondents' social distance to climate change. One question asks respondents if they perceive climate change having an effect on people like themselves, and another asks respondents if they believe that "climate change will mostly affect developing countries". Both items were recorded on a five point Likert scale ranging from "Strongly Agree" (1) to "Strongly Disagree" (5). As the target audience of this study resides in New York State, developing countries are considered to be socially distant to respondents. However, focusing on the difference between developing and developed countries emphases only one aspect of social distance, and perceiving the effects of climate change impacting people who are socially distant does not contradict the idea that climate change will also affect people who are socially proximate. In other words, it's reasonable to believe that developing countries will be greatly affected by climate change while also recognizing the potential for climate change to affect people in New York State. Indeed, this view may be accurate as many developing countries lack the resources to adequately adapt to climatic impacts (Rosenzweig & Parry, 1994). Although the original measures developed by Spence et al. (2012) analyzed these two items

individually, this study combines them into a social distance scale to examine the relationship between demographic variables and respondents' social distance to climate change. Component analysis of the social distance questions found a Cronbach's α of 0.008.

Temporal distance. Temporal distance to climate change was measured through a single item asking respondents when they think New York will start to feel the effects of climate change. Response options were constrained to a seven-point scale that ranged from "We are already feeling the effects" (1) to "Never" (7). When combined with the other sub-constructs to form the psychological distance scale, this item was modified from a seven-point scale to a five-point scale to align with the other items. Specifically, the item was recoded to combine the last three responses – "In the next 100 years", "Beyond the next 100 years", and "Never".

Spatial distance. Spatial distance to climate change was operationalized through two items assessing different dimensions of perceived spatial distance. Both questions asked respondents to state their agreement with the following statements: "My local area is likely to be affected by climate change", and "Climate change will mostly affect areas that are far away from here". Both items were recorded on a five point Likert scale ranging from "Strongly Agree" (1) to "Strongly Disagree" (5). Similarly, to the social distance operationalization, these questions were designed to be analyzed individually as the perception that one is true would not necessarily preclude the other. That is to say, it's reasonable to perceive that climate change will mostly affect distant areas while also holding the view that one's local areas will be affected by climate change. In fact, the view that climate change impacts will be more serious in distant areas relative to New York, for example the southern hemisphere, may be accurate (Field et al., 2014). Similar to the social distance sub-construct, these items were combined into a score for spatial distance to examine the relationship between respondents' demographics and their spatial

distance to climate change. A component analysis of the items assessing spatial distance found a Cronbach's α of 0.072.

Hypothetical distance. Respondents' hypothetical distance to climate change was operationalized through five items assessing different aspects of uncertainty and skepticism. Four of these items asked respondents to state their agreement with a series of statements regarding the uncertainty about the reality of climate change, the exaggeration of the significance of climate change, the scientific consensus on the reality of climate change, and the uncertainty regarding the effects of climate change. These four items were recorded through a five point Likert scale with response options ranging from "Strongly Agree" (1) to "Strongly Disagree" (5). The fifth item assessed respondents' perception regarding the causation of climate change by asking them to select the phrase that best described their opinion when thinking about the natural vs. anthropogenic forcing of climate change. Responses were recorded on a six-point scale with options ranging from "entirely caused by natural processes" (1) to "entirely caused by human activity" (5) with a sixth option, "I don't think there is such a thing as climate change" (6). Although all five of these items attempt to measure respondents' hypothetical distance to climate change, a principle component analysis of these five variables, as described in Spence, Poortinga, & Pidgeon (2012), resulted in an insufficient level of inclusion for the item addressing uncertainty regarding the effects of climate change. As such, this item was excluded from the combined score for hypothetical distance. The remaining four items were reversed where necessary and combined into a scale with a Cronbach's $\alpha = 0.71$. The item regarding the causation of climate change was recoded from a six-point scale to a five-point scale by combining the responses "I don't think there is such a thing as climate" and [climate change is] "entirely caused by natural processes". Component analysis of the collected farmer perception

data supports this method and indicates a slightly higher level of internal consistency (Cronbach's $\alpha = 0.74$).

Climate impact concerns. Respondents' concern regarding specific climate change impacts was assessed through a measure adapted from study examining attitudes and beliefs of farmers in the Midwestern United States (Arbuckle, et al., 2013). Arbuckle and colleagues (2013) asked farmers to rate their level of concern for four projected climatic impacts, specifically: "Longer dry periods and drought", "increased heat stress", "more frequent or extreme weather events", and "increased ponding water and flooding". Response options consisted of a four-point scale ranging from "Not concerned" (1) to "Very concerned" (4). This study utilized these four items with the respective response options. However, in addition to the four impacts included in the Arbuckle et al. (2013) study, this survey also included two possible institutional impacts related to climate change, specifically: "increased emission guidelines" and "higher fuel and energy prices". The response options for these two items followed the same framework. Additionally, the survey included in this study differed from the original by asking respondents if they had previously experienced each of the six impacts; this was recorded by circling "Yes", "No", or "Don't Know".

These items were not initially combined into an overall score for climatic impact concern. However, component analysis has indicated a high level of internal consistency between them (Cronbach's $\alpha = 0.87$). As such, the four original items were combined to form a climate impact concern scale for further analysis. The two items relating to potential institutional impacts were not included in this combined scale. Although there could be a logical relationship between climate change and increased regulation / increased energy prices, there are abundant external and unrelated factors that could lead to these impacts as well.

Willingness to pay. Willingness to pay for climate change mitigation was measured by one question adapted from a study examining the WTP and policy instrument preferences for climate mitigation among U.S. households (Kotchen, Boyle, & Leiserowitz, 2013). Kotchen and colleagues (2013) asked respondents how much they would be willing to pay per year to reduce U.S. GHG emissions 17% by the year 2020 through a randomized policy instrument – cap and trade, carbon tax, and labeling carbon dioxide as a pollutant. The current study eliminated the randomized treatment as it was interested in assessing respondents' support for any mitigation policy. Additionally, 2020 was changed to 2025 to reflect the 10-year payment period mentioned in the item text. The final question was worded as follows:

> "Congress is considering a mitigation policy that would reduce U.S. greenhouse gas emissions 17% by 2025. This policy would increase the cost of living for all American households. In support of this policy, what is the maximum amount your household would be willing to pay each year for the next 10 years? (Select one answer)"

Response options followed the format developed by Kotchen, Boyle, and Leiserowitz (2013) and contained nine choices ranging from "$0" (1) to "$475 or more" (8) along with an "I Don't Know" (9) option. The response options were selected through a process that started with two middle amounts ($157 and $193), then added two higher level options ($250 and $475) and two lower level options ($60 and $121). An option of $0 was included for respondents who would not pay anything for GHG mitigation, and an option of $26 was added to reflect the idea that some people may pay a modest amount to support GHG mitigation (Kotchen et al., 2013).

Table 3: Constructs included in the survey and their operationalization.

Construct	Item	Response Option
Flooding Experience	Have you previously experienced flooding in your area in the last 5 years?	*Yes, No, Don't Know*
Social Distance to climate Change (α = 0.008)	Climate change will mostly affect developing countries.	5 point Likert scale: *strongly agree* to *strongly disagree*
	Climate change is likely to have a big impact on people like me.	"
Temporal Distance to climate Change	When, if at all, do you think New York will start feeling the effects of climate change?	7 point scale ranging from *we are already feeling the effects - Never*
Spatial Distance to climate change (α = 0.072)	My local area is likely to be affected by climate change.	5 point Likert scale: *strongly agree* to *strongly disagree*
	Climate change will mostly affect areas that are far away from here.	"
Hypothetical Distance (α=0.75)	I am uncertain that climate change is really happening.	5 point Likert scale: *strongly agree* to *strongly disagree*
	The seriousness of climate change is exaggerated.	"
	Most scientists agree that humans are causing climate change.	"
	It is uncertain what the effects of climate change will be.*	"
	Which of the following best describes your opinion when completing the sentence; climate change is…	6 point scale from *entirely natural – entirely caused by humans, No such a thing*
Climate Risk Concern (α = 0.87)	Longer dry periods and drought	4 point scale: *Not concerned* to *very concerned*
	Increased heat stress	"
	More frequent of extreme weather events	"
	Increased ponding water and flooding	"
	Increased emissions guidelines*	"
	Higher fuel and energy prices*	"
Willingness to pay	Congress is considering a mitigation policy that would reduce U.S. greenhouse gas emissions 17% by 2025. This policy would increase the cost of living for all American households. In support of this policy, what is the maximum amount your household would be willing to pay each year for the next 10 years?	9 point scale ranging from $0 - $475 or more, Don't know

* This item was not included in the combined score

Data Analysis Plan

The data analysis will be conducted on Minitab software. First, a series of univariate analyses will summarize the survey data for both independent and dependent variables. Summarized data for individual survey items will be provided to give a more nuanced understanding of responses and allow for the comparison between results from this study and the studies it built upon (Arbuckle, et al., 2013; Kotchen et al., 2013; Spence et al., 2012). The remaining data analysis will be discussed in regard to each aforementioned Research Question (RQ). Missing data will be excluded from all analyses and *scores* for various constructs will only be calculated for respondents who answered all items within the appropriate measure.

RQ1, regarding farmers' psychological distance to climate change, will be examined by considering both the psychological distance construct as a whole as well as the four underlying dimensions (social distance, temporal distance, spatial distance, and hypothetical distance). A series of one-way ANOVAs will examine the relationships between demographic variables and respondents' psychological distance to climate change. If ANOVAs indicate a significant relationship, t-tests will be used to determine which demographic groups differ from one another. The null hypothesis for each analysis is that there is no association between a particular demographic variable and the respondent's psychological distance score (H_0: $\mu_1 = \mu_2$). Descriptive statistics will then be provided for items within each dimension. The four psychological distance dimensions will then be summed into an overall psychological distance *score* on a scale ranging from 9.0 (most proximal perception of climate change) to 45.0 (most distant perception of climate change).

RQ2, regarding respondents' level of concern for climatic impacts, will be examined in multiple steps. First, a series of univariate analyses will describe the respondents' overall

concern for the six climate impacts (RQ2-A). The four physical impacts will then be summed into an overall score and a series of one-way ANOVAs will examine the relationships between demographic variables and respondents' summed concern score. The null hypothesis for each analysis is that there is no association between a particular demographic variable and the respondent's concern score (H_0: $\mu_1 = \mu_2$). Finally, a series of one-way ANOVAs will test hypotheses regarding respondents' past experience of a particular impact with their concern for the same impact (RQ2-B). The null hypothesis in each circumstance is that prior experience of a particular weather event would *not* influence concern for that same event, that is, the mean concern scores for people who had experienced an event would be the same as those who had not (H_0: $\mu_1 = \mu_2$).

RQ3, regarding respondents' willingness to pay (WTP) for mitigation programs, will first be examined through a univariate analysis to describe the overall response pattern (RQ3-A). Second, due to the nature of the responses, WTP will be recoded into four categories: (1) – not willing to pay anything (i.e. response option "$0"); (2) – "Don't know"; (3) – willing to pay up to $200 (i.e. response options "$26" through "$193"); and (4) – willing to pay more than $200 (i.e. responses: "$250" and "$475 or more"). The associations between demographic variables and respondents' WTP (RQ3-B) will then be assessed through an ordinal logistic regression.

RQ4, regarding psychological distance and its potential role as a predictor of both level of concern for climatic impacts and willingness to pay, will be examined through a three-part analysis. First, Pearson's correlations will examine the relationship among the dimensions of psychological distance, respondents' summed concern score, and respondents' WTP (4-point scale) (RQ4-A). Second, a linear regression will be used to examine the association between psychological distance dimensions and respondents' concern for climate change impacts (RQ4-

B). For all subsequent regressions, the scores for each of the four psychological distance dimension will be divided by the number of items within the dimension to account for the different potential ranges due to differing number of items per dimension (i.e., 1, 2, or 4). Thus, each dimension's score will be on a 5-point scale. The final analysis in regard to RQ4 will assess the relationship between psychological distance dimensions, climate impact concern, and WTP for climate mitigation through a two-part ordinal regression (RQ4-C). WTP will be coded on the same 4-point scale as described in RQ-3. An ordinal logistic regression of WTP against psychological distance dimensions will be used to assess which dimensions of psychological distance are associated with WTP. A subsequent regression will include climate impact concern scores to further assess the relationship between psychological distance, WTP, and climate impact concern.

RQ5, regarding the association of flooding exposure with dependent variables (A) psychological distance and (B) WTP, will be examined through a series of independent sample t-tests and chi-square analyses. Each analysis will compare the psychological distance and WTP of respondents who have experienced flooding in the last five years to the scores of those who have not. Those who answered "I don't know" will not be included in this analysis. Each of the four dimensions of psychological distance will be analyzed in addition to respondents' overall psychological distance score; and WTP. The null hypothesis in both scenarios is that there is no difference in either psychological distance or WTP between respondents who have experienced flooding and those who have not (H_0: $\mu_1 = \mu_2$).

RESULTS

How psychologically distant is climate change in the minds of NY farmers?

The first research question examines farmers' psychological distance. Psychological distance is likely not a uni-dimensional construct. As such, this section will first report the results of analyses examining each of the four dimensions of psychological distance. Descriptive results of the response rates to each item within a particular dimension's metric will be presented, followed by a calculated score. These results provide a more nuanced understanding of how respondents view climate change, and allow for the comparison between studies utilizing similar metrics. After reviewing the results from each dimension of psychological distance, the calculated scores will be combined into an overall psychological distance score.

Social distance of climate change. The social distance scale consisted of two items with response options ranging from 1 (Strongly Agree) to 5 (Strongly Disagree), resulting a potential range of 2.0 (socially proximal) to 10.0 (socially distal). Of the 109 people who responded to both questions within the social distance scale, the mean score was 4.79 with a standard deviation of 1.53 with a minimum recorded score of 2.0 and a maximum recorded score of 8.0. A series of one-way ANOVAs revealed a significant difference in respondents' social distance to climate change based on their educational levels, $F= 2.91$, $p = 0.05$. Respondents who had completed a graduate degree reported statistically lower social distance scores than those who had not completed high school ($\overline{x} = 5.33$, $p = .002$); those who had completed high school ($\overline{x} = 5.00$, $p = .015$); those with and associate's or technical degree ($\overline{x} = 5.3$, $p = .046$). No significant relationships were found between social distance scores and other demographic variables (age, gender, farm size, farm age, income, relationship to farm, or farm commodity). The social

distance means and standard deviations for each independent variable are shown in Table 1. There were no significant interactions revealed in the analysis.

Table 1: Relationship between social distance scores and demographic variables. Scale ranges from 2.0 to 10.0.

Characteristic		Mean	sd	n	Characteristic		Mean	Sd	n
Gender	Male	4.91	1.47	54	**Education***	No high school	5.33	0.86	9
	Female	4.58	1.58	48		High school	5.00	1.41	15
						Some college	5.30	1.42	20
Age	< 25	5.27	0.88	15		Associates	4.87	1.77	15
	25-34	4.67	1.80	9		Bachelors	4.54	1.45	26
	35-44	4.81	1.64	16		Graduate*	3.60	1.55	15
	45-54	5.06	1.39	17					
	55-64	4.43	1.68	30		Minimum score	2.0		
	65-74	4.27	1.73	11		Maximum score	8.0		
	> 75	5.50	0.71	2					

* $p < .05$

The majority of participants responded either “strongly agree” (28.2%) or “tend to agree” (40.0%) with the statement “climate change is likely to have a big impact on people like me”. Moreover, roughly half of respondents indicated that they “strongly disagree” (16.5%) or “tend to disagree” (34.9%) with the statement: “climate change will mostly affect developing countries”. Slightly over one quarter (26.6%) of respondents were “uncertain” about this statement. The results from the items assessing social distance to climate change, which are summarized in Figure 2, suggest that respondents are cognizant of the socially proximal effects of climate change.

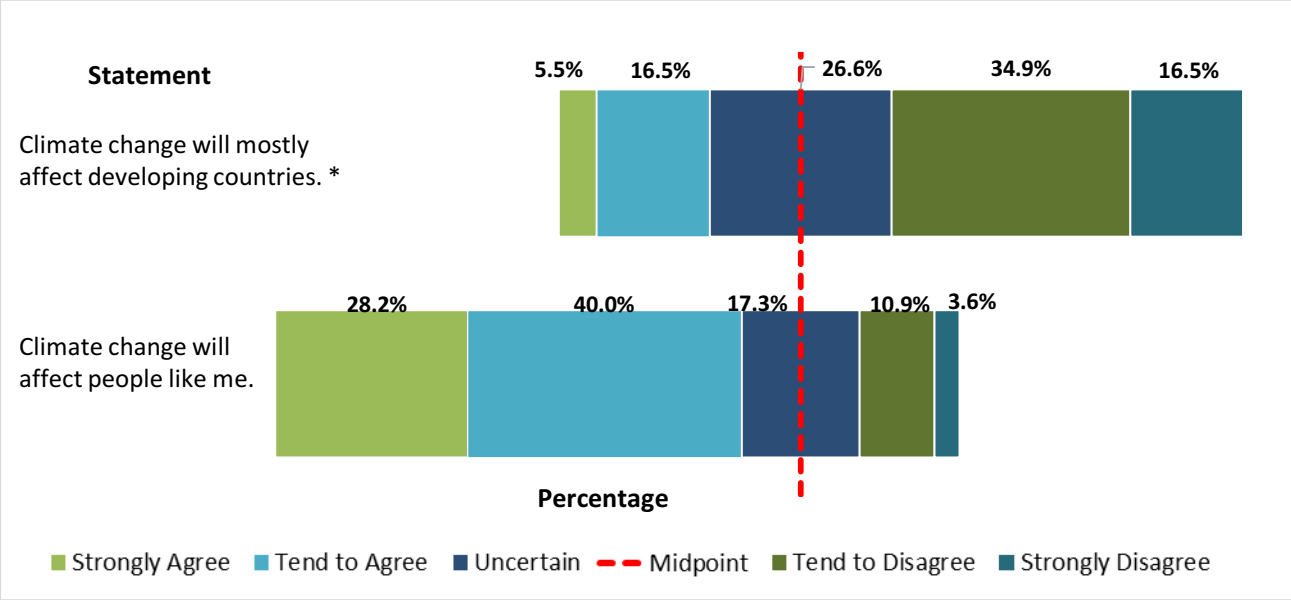

Figure 2: Responses to statements addressing social distance to climate change (n=109)

* This item was reversed during analysis so that higher scores indicate more distal interpretations of climate change. Participants' original responses are shown in this figure.

Temporal distance to climate change. When asked: "when, if at all, do you think New York will start feeling the effects of climate change", the majority (71%) of respondents selected "We are already feeling the effects of climate change," as summarized in Figure 3. An ordinal logistic regression of demographic variables revealed that both education and gender ($z = 2.84$, $p = .004$) were significantly associated with participants' temporal perception of climate change. On average, women[2] ($\bar{x} = 1.33$) were more likely than men ($\bar{x} = 2.15$) to view climate change as temporally proximal. Moreover, temporal distance tended to decrease as educational attainment increased ($z= 2.09$, $p = .037$). With each additional level of education achieved, respondents were, on average, 1.4 times more likely to select "we are already feeling the impacts of climate change".

[2] Mean temporal distance reflects coding responses from 1-7 with 1 being "we are already feeling the effects".

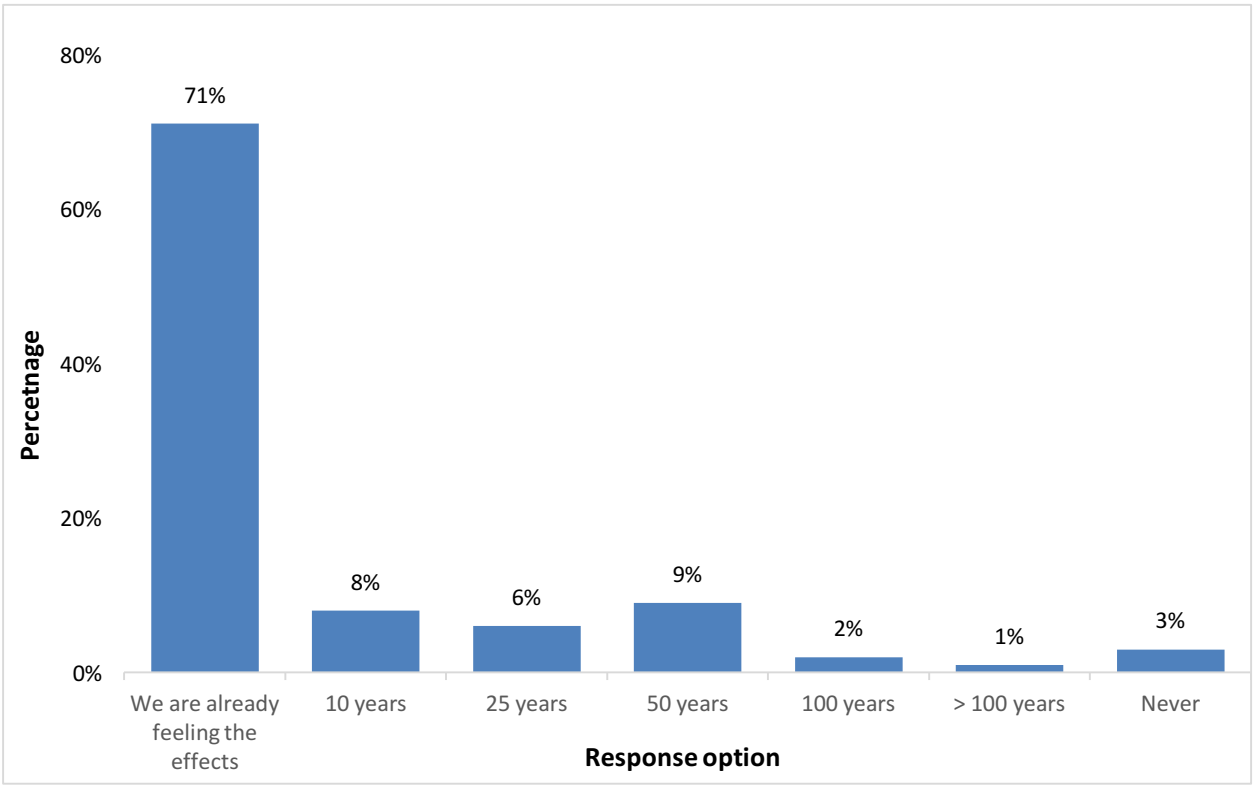

Figure 3: Responses to statement: "When if at all do you think NY will start feeling the effects of climate change?" (n= 105)

Spatial distance of climate change. The spatial distance scale consisted of two items with response options ranging from 1 ("Strongly Agree") to 5 ("Strongly Disagree"), resulting a potential range of 2.0 (spatially proximal) to 10.0 (spatially distal). The mean spatial distance of the 109 people who responded to all items was 4.68 with a standard deviation of 1.71, with a minimum recorded score of 2.0 and a maximum recorded score of 9.0. A series of one-way ANOVAs between demographic variables and spatial distance revealed age to be significantly associated with spatial distance, $F = 3.37$, $p=0.005$. Specifically, respondents under the age of 25 ($\bar{x} = 5.87$) reported higher spatial distance scores than those between the ages of 35-44 ($\bar{x} = 4.88$, $p = .025$); 55-64 ($\bar{x} = 3.79$, $p = .000$); 65-74 ($\bar{x} = 4.0$, $p = .005$). Moreover, respondents between the ages of 55-64 ($\bar{x} = 3.79$) reported lower spatial distance scores than those between the ages of 35-44 ($\bar{x} = 4.88$, $p = .034$); 45-54 ($\bar{x} = 5.0$, $p = .035$). Education was also revealed to be

significantly associated with spatial distance, F=3.07, p =0.013. A series of t-tests revealed that respondents who had completed a graduate degree ($\overline{x}$ = 3.33) reported statistically lower scores that those who had not completed high school ($\overline{x}$ = 5.67, p = .000); those who had completed high school ($\overline{x}$ = 4.93, p = .01); those who had a bachelor's degree ($\overline{x}$ = 4.89, p = .005). In addition to reporting higher scores than those who had a graduate degree, respondents who had not completed high school ($\overline{x}$ = 5.67) reported statistically higher scores than those with an associate's degree ($\overline{x}$ = 4.27, p = .012). Spatial distance means and standard deviations for all three independent variables are shown in Table 2. There were no significant relationships between spatial distance scores and respondents' farm demographic variables (i.e. farm size, farm age, income, respondent's relationship to farm).

Table 2: Relationship between spatial distance scores and demographic variables. Scale ranges from 2.0 to 10.0

Characteristic		Mean	sd	n	Characteristic		Mean	sd	n
Gender	Male	4.76	1.69	54	**Education***	No high school*	5.67	0.87	9
	Female	4.52	1.75	48		High school	4.93	1.54	14
						Some college	4.90	1.86	20
Age*	< 25*	5.87	0.74	15		Associates	4.27	1.62	15
	25-34	4.89	1.97	9		Bachelors	4.89	1.76	27
	35-44	4.88	1.46	16		Graduate*	3.33	1.54	15
	45-54	5.00	1.80	17					
	55-64*	3.79	1.80	29		Minimum score	2.0		
	65-74	4.00	1.67	11		Maximum score	9.0		
	> 75	5.33	1.16	3					

* p< 0.05

The individual responses for each item assessing spatial distance to climate change are shown in Figure 4. The majority of people who responded to the statement "my local area is likely to be affected by climate change" either "strongly agree[d]" (31.9%) or "tend[ed] to agree" (36.4%). Moreover, most people also either "strongly disagree[d]" (26.6%) or "tend[ed] to disagree" (30.3%) with the statement "climate change will mostly affect areas that are far away

from here." Responses from these two items suggest that respondents are aware of the spatially proximal effects of climate change.

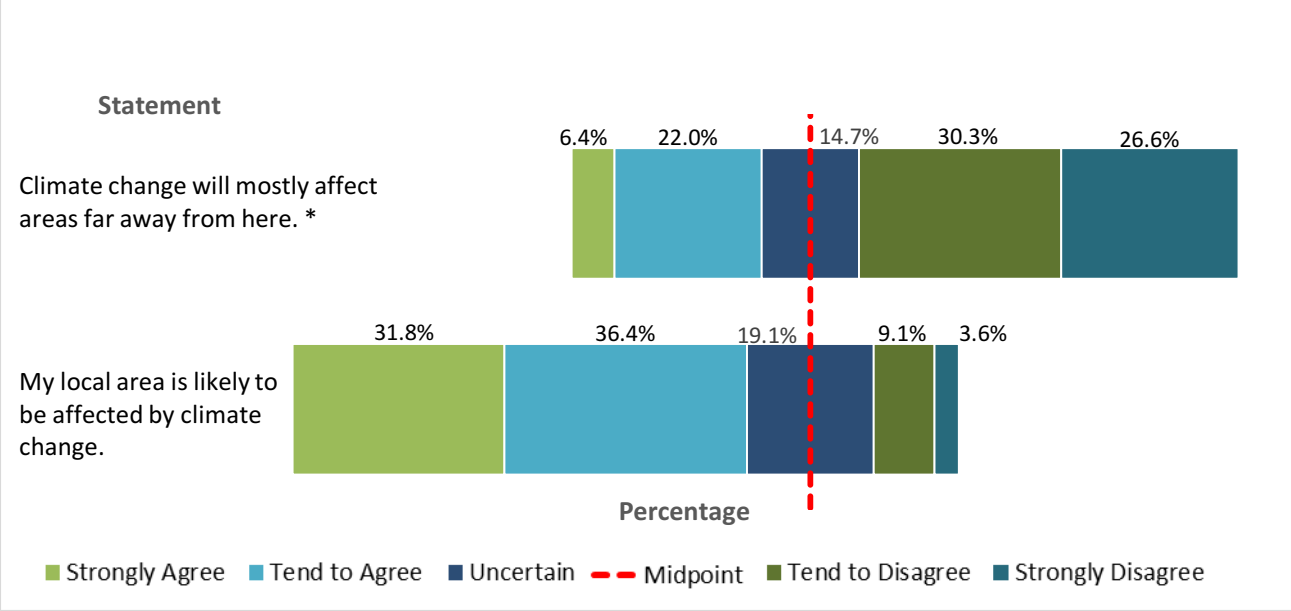

Figure 4: Responses to statements addressing spatial distance to climate change

* This item was reverse coded during analysis so that higher scores indicate more distal interpretations of climate change. Participants' original responses are shown in this figure.

Hypothetical distance of climate change. The scale for hypothetical distance consisted of 4 items with response options ranging from 1 ("Strongly Agree") to 5 ("Strongly Disagree"), with a potential range of 4.0 (hypothetically proximal) to 20.0 (hypothetically distal). Of the 108 people who responded to all four of the items, the mean score was 10.65 with a standard deviation of 3.62 with a minimum recorded score was a 4.0 and a maximum recorded score of 20.0. The means and standard deviations are shown in Table 3. A series of one-way ANOVAs found a significant association between hypothetical distance and education, $F= 4.16$, $p=0.002$. Respondents who had completed a graduate degree ($\bar{x} = 8.13$) reported statistically more proximal scores than those who had not completed high school ($\bar{x} = 12.67$, $p = .005$); those who had completed high school ($\bar{x} = 11.93$, $p = .005$); those who had an associates or technical degree ($\bar{x} = 10.27$, $p = .056$). In addition to reporting statistically higher scores than respondents with

graduate degrees, respondents who had not completed high school reported statistically higher scores than those who had bachelor's degree ($\bar{x}$ = 9.78, p = .04). Respondents' farm demographics were not found to be statistically associated with their hypothetical distance scores.

Table 3: Relationships between hypothetical distance scores and demographic variables. Scale ranges from 4.0 to 20.0

Characteristic		Mean	sd	n	Characteristic		Mean	sd	n
Gender	Male	11.15	3.91	54	**Education***	No high school	12.67	3.32	9
	Female	10.00	3.22	47		High school	11.93	3.52	14
						Some college	11.58	4.19	19
Age	< 25	10.79	2.88	14		Associates	10.27	2.63	15
	25-34	8.44	3.40	9		Bachelors	9.78	3.23	27
	35-44	11.07	3.06	15		Graduate*	8.13	3.20	15
	45-54	10.71	3.57	17					
	55-64	10.53	4.34	30		Minimum score	4.0		
	65-74	10.09	2.98	11		Maximum score	20.0		
	> 75	16.0	3.00	3					

* p < .05

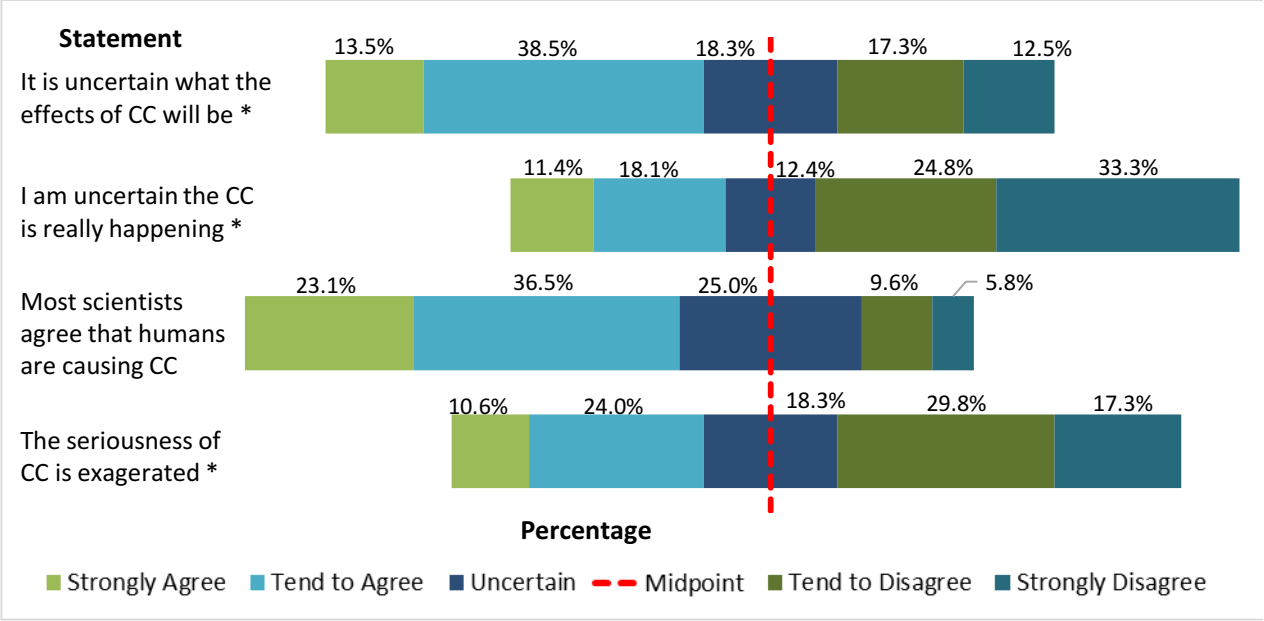

Figure 5: Responses to statements addressing hypothetical distance to climate change

* This item was reverse coded during analysis so that higher scores indicate more distal interpretations of climate change. Participants' original responses are shown in this figure.

Results from the four Likert items within the hypothetical distance measure are shown in Figure 5. Most respondents either "strongly agree[d]" (13.5%) or "tend[ed] to agree" (38.5%) with the statement "it is uncertain what the effects of climate change will be". However, more respondents agreed than disagreed that climate change is really happening. When asked about their uncertainty, 33.3% of respondents stated that they "strongly disagree" with the statement; "I am uncertain that climate change is really happening", and nearly a quarter (24.8%) of respondents "tend[ed] to disagree" with the statement. Furthermore, the majority of respondents either "strongly agree[d]" (23.1%) or "tend[ed] to agree" (36.5%) with the statement: "most scientists agree that humans are causing climate change". In addition to their perception of the scientific consensus on the causation of climate change, respondents were asked to state their own attitudes regarding anthropogenic climate change. When asked to complete a sentence regarding climate change causation, most respondents tended to select one of the options stating that humans have played at least some role in contributing to climate change. The results, shown in Figure 6, indicate that 54.4% of respondents chose the statement: "Climate change is partly caused by natural processes and partly caused by human activity", while another 22.3% or respondents chose the option: "climate change is mainly caused by human activity". Only a small fraction (5.8%) of respondents selected: "I don't believe there is such a thing as climate change".

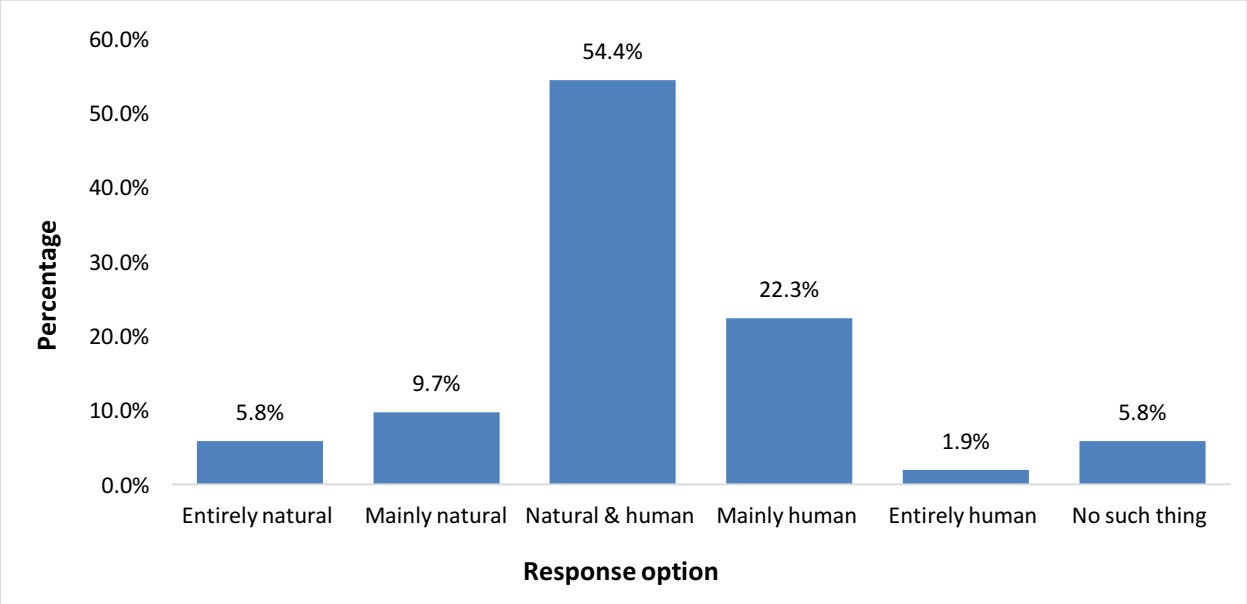

Figure 6: Response to item addressing climate change attribution. Respondents were asked to select the phrase that best completes the sentence: "Climate change is…" (n=110)

Combined psychological distance score. The overall psychological distance score was calculated for people who responded to all items within the measure (n=102) by summing the scores from each psychological distance dimension. Temporal distance was recoded to a 5-point scale by collapsing the last three response options ("In the next 100 years", "Beyond 100 years", and "Never"). As such, the final scale consisted of 9 items with response options ranging from 1 (representing the psychological proximity) to 5 (representing psychological distance), resulting a range of 9.0 to 45.0. The mean psychological distance of respondents (RQ1-A) was 21.27 with a standard deviation of 6.04 with a minimum recorded score of 9.0 and a maximum recorded score of 37.0. A histogram of the recorded psychological distance scores, shown in Figure 7, suggests a wide range of variance among respondents.

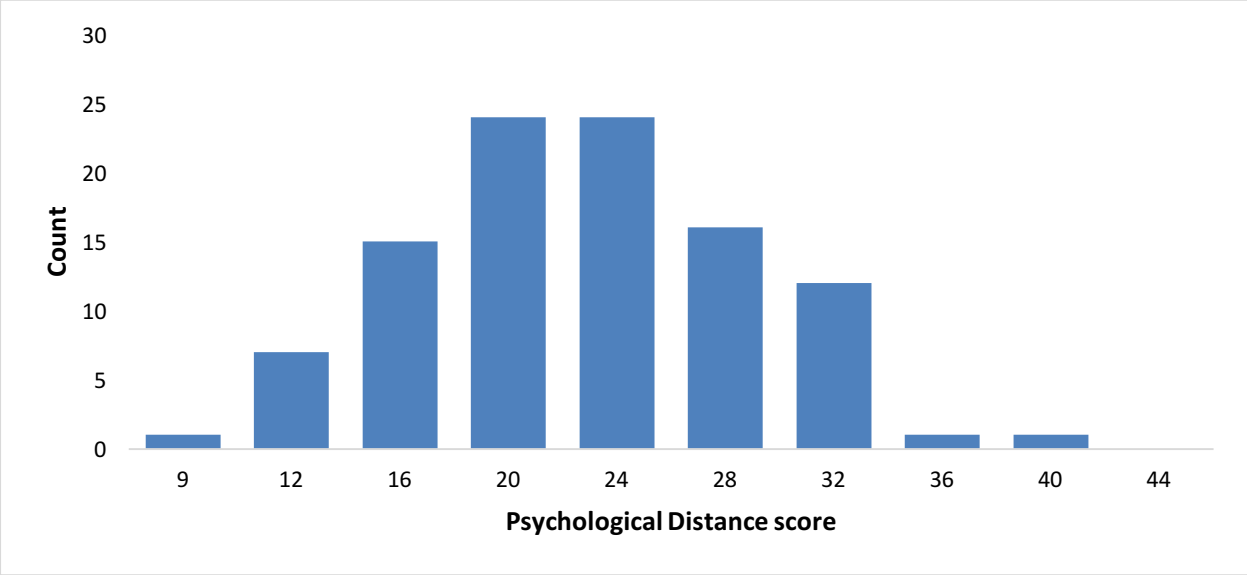

Figure 7: Distribution of psychological distance scores (n=102)

A series of one-way ANOVAs were conducted to identify associations between demographic variables and psychological distance. The results from each one-way ANOVA related to respondents' personal demographics (age, gender, education. etc.) are shown in Table 4. A significant association was found between educational attainment and psychological distance, $F = 4.36$, $p = .001$. Generally, psychological distance tended to decrease as education increased. A series of two sample t- tests revealed that respondents who had not completed high school ($\bar{x} = 25.38$) reported statistically higher levels of psychological distance than those who had an associate's degree ($\bar{x} = 20.60$, $p = .047$); bachelor's degree ($\bar{x} = 20.53$, $p = .038$); and graduate degree ($\bar{x} = 16.13$, $p = .001$). Moreover, respondents who had completed a graduate degree ($\bar{x} = 16.13$) reported statistically lower levels of psychological distance than all five other levels of educational attainment (No H.S: $\bar{x} = 25.38$, $p = .001$; H.S: $\bar{x} = 23.85$, $p = .001$; A.S.: $\bar{x} = 20.60$, $p = .015$; B.S.: $\bar{x} = 20.53$, $p = .015$; $\mu = 21.27$, $p = .003$). There were no significant relationships between psychological distance scores and respondents' farm demographics (farm size, relationship to farm, farm commodity, farm age, and income).

Table 4: Relationship between psychological distance and demographic variables. Scale ranges from 9.0 to 45.0

Characteristic		Mean	sd	n	Characteristic		Mean	sd	n
Gender	Male	22.18	6.33	50	**Education***	No high school*	25.38	5.15	8
	Female	19.87	5.19	45		High school	23.85	5.84	13
						Some college	21.63	6.45	16
Age	< 25	24.0	4.30	14		Associates	20.60	4.52	15
	25-34	19.33	6.61	9		Bachelors	20.53	4.89	26
	35-44	22.73	5.32	15		Graduate*	16.13	5.37	15
	45-54	21.56	5.10	16					
	55-64	18.85	6.67	26		Minimum score	9.0		
	65-74	19.91	6.02	11		Maximum score	37.0		
	> 75	27.0	2.83	2					

* $p > 0.05$

What level of concern do NY farmers express for certain projected climatic impacts?

The second research question (RQ2) examines farmers' concern regarding climatic impacts. Of the six climate impacts examined, "higher fuel and energy prices" received the highest rating of concern with 77.6% of respondents being either "very concerned" or "concerned". "More frequent or extreme weather events" was rated as the impact with the second highest level of concern, with 65% of respondents being either "very concerned" or "concerned". The impacts with the least amount of concern among respondents were "increased ponding water and flooding" and "increased emission guidelines", with 15% and 14.4% of respondents (respectively) stating that they are not concerned. Descriptive results from the questions targeting climate impact concerns are shown in Figure 8

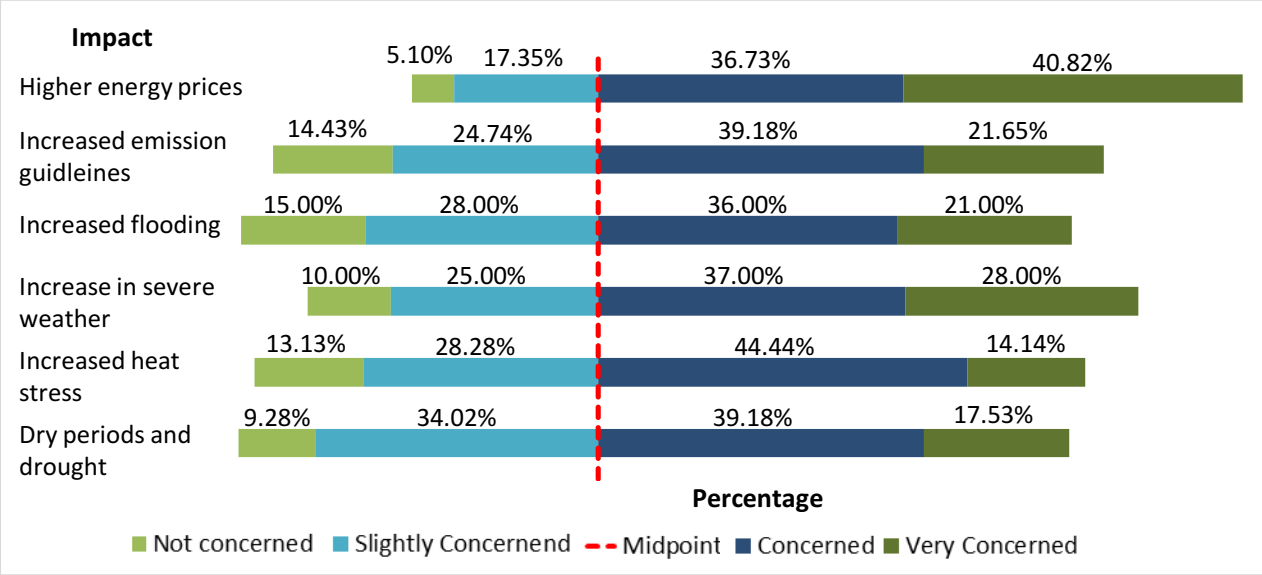

Figure 8: Response rates of concern for specific climate impacts

The four items dealing with physical impacts of climate change were combined into a single score with higher scores representing increased levels of concern. The two items representing potential institutional impacts – "increased emission guidelines" and "higher energy prices" were not included in this scale. Although both these concepts are potential consequences of climate change, there are a number of external and unrelated factors that could likely result in them as well. The combined 4-item scale for climate impact concern had a maximum possible score of 16.0 (highest concern) and a minimum score of 4.0 (least concern). Of the 100 people who responded to all four items addressing concern for physical impacts, the mean score was 9.27 with a standard deviation of 3.23 with a minimum recorded score of 4.0 and the maximum recorded score of 16.0. A series of one-way ANOVAs did not reveal any significant relationships between respondents' demographic variables and climate impact concern scores.

In addition to rating their level of concern for each of the projected impacts, respondents were also asked if they have experienced each impact (i.e. drought, heat stress, flooding, severe weather, increased energy prices, increased emission guidelines) (RQ2-B). Respondents'

experience with impacts potentially associated with climate change is outlined in Table 5. A series of one-way ANOVAs revealed that there is a significant relationship between respondents' concern and their prior experience for five of the six impacts listed (increased emission guidelines was not significantly associated with prior exposure). Typically, respondents who had prior experience with a particular impact stated a higher level of concern than those who had no previous experience. Furthermore, people who were unsure if they had experienced a particular impact tended to be more concerned than those who had not experienced the impact, but not as concerned as respondents who had. However, "longer dry periods and drought" was the one exception to this pattern. Respondents who were uncertain if they had experienced "longer dry periods and drought" were more concerned about the potential impact of drought than both respondents who had and had not experienced it the past. The results from the analysis exploring respondents' previous exposure and level of concern for potential impacts is shown in Table 6.

Table 5: Respondents' experience with potential climate impacts

Impact	yes	no	Don't know	n
Longer dry periods and Drought	44.4%	46.9%	8.6%	81
Increased Heat Stress	39.7%	44.9%	15.4%	78
More frequent or extreme weather events	71.3%	18.8%	10.0%	80
Flooding within the last five years	60.7%	35.5%	3.7%	107
Increased emission guidelines	38.2%	34.2%	27.6%	76
Higher fuel and energy prices	84.4%	9.1%	6.5%	77

Table 6: Climate impact concern scores across prior experience. Scale ranges from 0.0 to 4.0.

Impact	**Experience**	**$\bar{x}$**	**sd**	n	**Impact**	**Experience**	**$\bar{x}$**	**sd**	n
Drought	Yes**	2.97	0.82	38	Heat Stress	Yes**	3.10	0.83	31
	No	2.19	0.82	36		No	2.23	0.91	35
	Don't Know	3.14	1.07	7		Don't Know	2.54	0.78	13
Extreme Weather	Yes**	3.13	0.85	60	Flooding	Yes**	3.06	0.89	48
	No	2.07	1.07	14		No	2.07	1.02	30
	Don't Know	2.37	0.92	8		Don't Know	2.33	0.56	3
Increased Regulation	Yes	2.90	0.99	30	Energy Prices	Yes*	3.27	0.83	66
	No	2.36	0.99	25		No	2.29	1.25	7
	Don't Know	2.45	1.10	20		Don't Know	2.75	0.96	4

** = p<0.05; ** = p<0.01*

How much are New York farmers willing to pay for a climate change mitigation program?

The third research question (RQ3) concerns willingness to pay for climate change. This construct was assessed through a single question asking respondents how much they would be willing to pay per year to reduce GHG emissions in the U.S. 17% by the year 2035. Of the 98 people who responded, the majority were either uncertain (36.7%) or were unwilling to pay anything (29.6%) to reduce national GHG emissions. Of the 33 respondents who stated that they would pay for mitigation strategies, 10.2% selected the highest possible amount. The results are shown in Figure 9.

Due to the response pattern, WTP responses were first recoded to reflect 4 options: (4) - willing to pay more than $200 (i.e. responses "$250" and "$475 or more"); (3) – willing to pay less than $200 (i.e. responses "$26" through "$293"); (2) - uncertain (i.e. response option "Don't know"), and (1) willing to pay *nothing* (i.e. response option "$0"). An ordinal logistic regression revealed that WTP was significantly associated with education ($z = -3.23$, $p = .001$), and women tended to be more likely to select a greater WTP response option than men ($z=-1.93$, $p = .53$). On average, people were approximately 35% more likely to select a greater WTP response option with each additional level of education attained. Individuals' demographic variables (i.e. age, gender, education) did not significantly predict if respondents would be more likely to respond "Don't know" than "$0". Furthermore, there were no significant associations between respondents' WTP for climate mitigation and the captured farm demographics (i.e. farm age, farm size, commodity, relationship to farm, income)

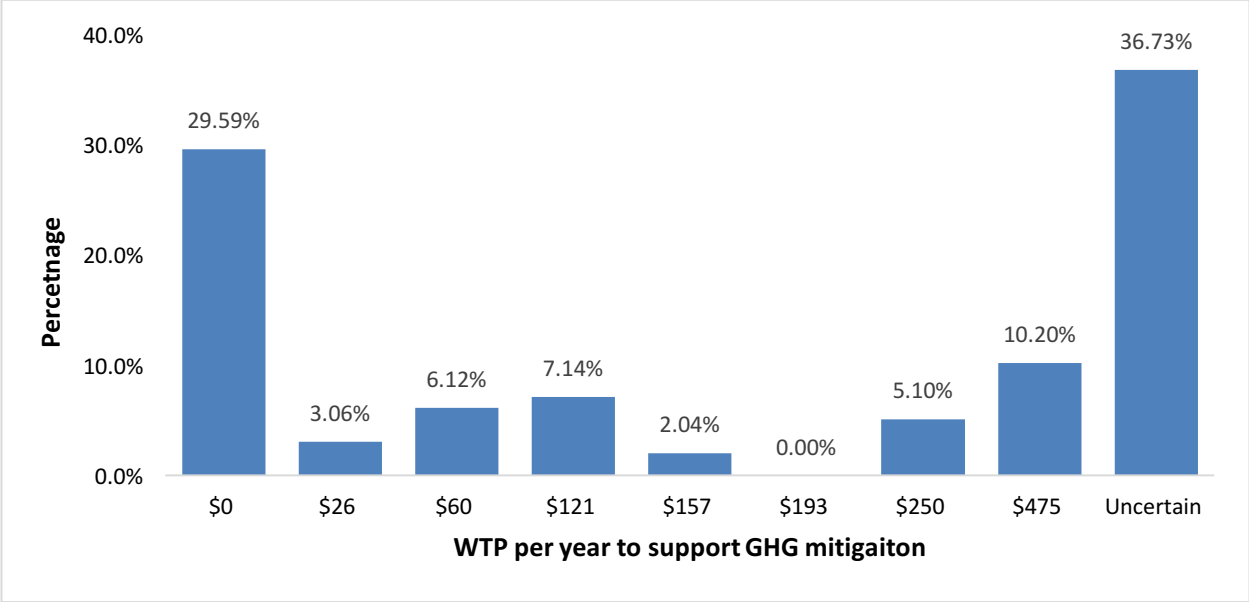

Figure 9: Response rates of WTP for GHG mitigation policy. n=98

What are the relationships between the four dimensions of psychological distance, climate impact concern, and willingness to pay for climate mitigation?

As mentioned, psychological distance is likely not a uni-dimensional construct. To investigate the relationship between the hypothesized aspects of psychological distance (RQ4-A), the scales were modified so that higher numbers represent greater psychological distance. Table 7 shows the Pearson correlation coefficient between each dimension of psychological distance as well as respondents' WTP and climate impact concern score. Using Cohen's convention for interpreting effect sizes, small=0.10, moderate=0.30, large = 0.50, we observe that respondents' social distance scores are strongly associated with their spatial distance scores as well as their combined concern for physical impacts of climate change. Additionally, climate impact concern scores are strongly associated with respondents' hypothetical distance scores. Perhaps not surprisingly, respondents' WTP for climate mitigation programs is negatively associated with all four dimensions of psychological distance (social and hypothetical distance

dimensions both have moderate associations with WTP). However, interestingly, WTP is also negatively associated with climate impact concern.

Table 7: Correlation between psychological distance dimensions.

	1	2	3	4	5	6
Social Distance (1)	1.00					
Temporal (2)	0.30	1.00				
Spatial Distance (3)	0.57*	0.38	1.00			
Hypothetical Score (4)	0.38	0.40	0.43	1.00		
Concern score (5)	0.58*	0.49	0.47	0.58*	1.00	
WTP (6)	-0.42	-0.35	-0.30	-0.53*	-0.51*	1.00

* denotes correlation greater than 0.50

Relationship between psychological distance and climate impact concern and WTP. As mentioned, the scale for physical climate impact concerns ranged from 4.0 to 16.0 with a mean score of 9.27 and standard deviation of 3.23. Respondents' climate impact concern score was associated with all four dimensions of psychological distance (RQ4-B). A regression was performed to further understand this relationship. The results from this regression are shown in Table 8. Social distance, temporal distance, and hypothetical distance all had significant relationships to concern for projected impacts from climate change. Altogether, these variables explained 47.4% of variance of the recorded climate impact concern data. Variance inflation factors ranged from 1.3 to 1.6, suggesting that collinearity is not a problem in this analysis.

Psychological distance was further regressed on respondents' WTP for climate mitigation through a two-step regression – first alone and secondly along with respondents' impact concern scores (RQ4-B). The results of this regression are shown in Table 9. Social distance and hypothetical distance were significantly related to respondents' WTP for climate mitigation policies. Further regressing WTP against climate impact concern had little effect on the model. The addition of respondents' impact concern as an independent variable made social distance an insignificant predictor, however impact concern was also revealed to be insignificant.

Table 8: Regression of psychological distance on climate impact concern scores

Dimension	β	SE	p
Social Distance	-1.38	0.36	0.001
Temporal	-0.62	0.22	0.005
Spatial distance	-0.23	0.35	0.520
Hypothetical distance	-1.15	0.33	0.001
Adjusted R^2	47.8%		

Table 9: Ordinal regression of psychological distance on respondents' WTP for mitigation policy

	WTP β	SE	p	WTP β w/ concern	SE	p
Social Distance	0.69	0.32	.030	0.67	0.36	.063
Temporal	0.26	0.19	.184	0.35	0.22	.104
Spatial distance	-0.13	0.28	.640	-0.18	0.31	.550
Hypothetical distance	1.30	0.30	.000	1.31	0.34	.000
Impact concern				-0.09	0.09	.343

How is previous exposure to flooding related to farmers' psychological distance to climate change and their willingness to pay for a mitigation program?

The fifth research question (RQ5) examines the relation between farmers' exposure to flooding and their psychological distance to climate change as well as to their willingness to pay for climate change mitigation. Of the 107 people who responded to the question asking about prior flood experience, 61% stated that they had experienced flooding within the last five years. Four people did not know if they had experienced flooding or not, these responses along with the three blank responses were left out of this analysis. A two-sample t-test indicated that there was a significant relationship between respondents' previous exposure to flooding and their psychological distance scores (RQ5). Respondents who had experienced flooding in the last five years tended to view climate change as more psychologically proximal ($\bar{x} = 20.23$) than those who had not ($\bar{x} = 22.83$; $p = 0.039$). However, interestingly, when examining the effects of prior flood experience on each individual dimension of psychological distance, only hypothetical distance was significantly related. Individuals who had experienced flooding tended to view

climate change as more hypothetically proximal ($\overline{x}$ = 10.1) than those who had not ($\overline{x}$ = 11.7; p = 0.034). That being said, the social and spatial distance scales consist of two weakly associated items. When these items are analyzed individually, significant relationships emerge. Perhaps unsurprisingly, people who have experienced flooding were more likely to agree ($\overline{x}$ =1.9) than those who had not experienced flooding ($\overline{x}$ =2.5) that their local area would likely be affected by climate change (p = 0.004). Furthermore, people who had experienced flooding were more likely to agree ($\overline{x}$ =1.95) that people similar to themselves would be affected by climate change than those who had not experienced flooding ($\overline{x}$ =2.5) (p = 0.011).The difference in responses for people who have experienced flooding compared to those who have not is shown in Figure 10.

To assess the association between flood experience and respondents' WTP for climate mitigation (RQ5-B) a series of analyses were conducted. First, given the nature of responses, WTP responses were coded into 4 categories: (1) - willing to pay nothing; (2) - "Don't know"; (3) - willing to pay something, but less than $200; and (4) – Willing to pay more than $200. A chi-square analysis found no significant difference in WTP between respondents who had experienced flooding and those who had not. However, there was a significant relationship between flood experience and WTP among respondents who *did know* what they would pay. To examine, response options were recoded to reflect the monetary values they represent ("Don't know" responses were excluded). A two sample t-test revealed a significant difference between flood experience and WTP. Of people who were certain what they would pay for climate mitigation, respondents who had experienced flooding were willing to pay an average of $164, while those who had not experienced flooding were willing to pay an average of $67 (p = 0.025).

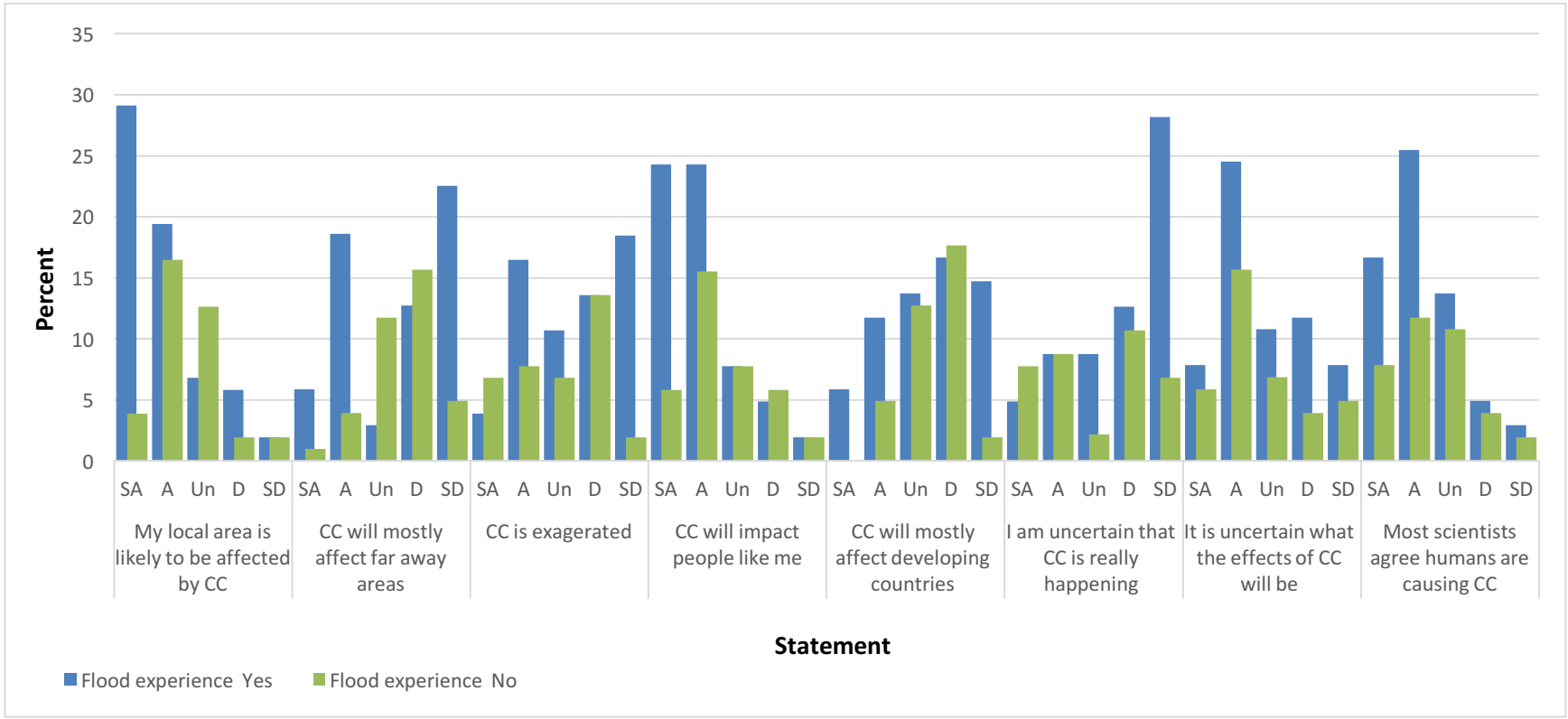

Figure 10: Responses to psychological distance statements by flood experience. *Climate change* abbreviated to "CC". SA = Strongly Agree; A = Agree; Un = Uncertain; D= Disagree; SD = Strongly Disagree.

DISCUSSION

New York State contains a diverse and robust agricultural sector that is a critical component of the State's economy and culture. Climate change has the potential to both positively and negatively impact aspects of agriculture throughout NY. This study aimed to explore NY farmers' attitudes and beliefs about climate change through a cross sectional survey of farmers attending an agricultural trade show in central NY. This chapter begins with a discussion of the results of each research question in a broader context, considering how the findings fit with existing literature; next, limitations of this study are recognized; implications are considered; and future research directions are identified.

How psychologically distant is climate change in the minds of NY farmers?

There are few prior studies that explore climate change perceptions through the lens of psychological distance, and none specifically targeting farmers. In this study, respondents showed a broad range of psychological distance to climate change with scores ranging from 9.0 to 37.0. The mean score was 21.7 and the median was 21.0 (the overall scale ranged from 9.0 to 45.0). Considering the constructed scale ranged from 9.0 to 45.0, the midpoint of the scale would be 27. Respondents' mean and median scores were approximately 6 points below the midpoint of the constructed psychological distance scale suggesting a relatively proximal view of climate change among respondents. Of all the independent variables, education was the only one found to have a significant relationship with respondents' overall psychological distance score; psychological distance tended to decrease as educational attainment increased. Respondents who had not completed high school reported scores significantly higher (more distal) than those who had a college degree (A.S., B.S., or graduate). Respondents who had completed a graduate degree scored significantly lower (more proximal) than the all other levels of educational

attainment. This pattern between educational attainment and psychological distance to climate change was repeated throughout this study. In every dimension of psychological distance, respondents with a graduate degree reported the most proximal scores, while those who had not completed high school reported the most distal scores. Interestingly, there tended to be little difference in psychological distance scores between the middle four educational levels (i.e. high school, some college, A.S or technical, or B.S.).

The single score for psychological distance to climate change seems to suggest that respondents lean slightly to the more proximal side of the psychological distance spectrum. However, it is important to note that previous studies suggest that psychological distance is not a uni-dimensional construct (Spence, Poortinga, & Pidgeon, 2012; Trope & Liberman, 2010). Which is to say that individuals' perceptions of climate change can vary across psychological distance dimensions (e.g. an individual could reasonably view climate change as hypothetically proximal but temporally distant). As such, it is pertinent to discuss each of the four dimensions of psychological distance to climate change (i.e., social distance, temporal distance, spatial distance, and hypothetical distance) individually to develop a more nuanced understanding of how participants in this study view climate change.

Social distance to climate change. Extant studies suggest that people may view the effects of climate change as having a greater impact on people and places that are socially distant from themselves. For instance, Leiserowitz, Maibach, & Roser-Renouf, (2009) show that the rate at which people tend to perceive climate change as affecting people "a great deal" increases as they consider people socially (and spatially) farther than themselves (e.g. individual to family to community to U.S. to other developed countries to developing countries). Although the current study frames the question differently, the results suggest a much more socially proximal

interpretation of the impacts of climate change in the minds of participating NY farmers. Overall, respondents scored one point below the midpoint of the 9 point constructed social distance scale, suggesting a relatively low level of social distance to climate change (they viewed climate change as socially proximal).

As Spence and colleagues (2012) did not combine the items assessing social distance to climate change into a combined scale, scaled social distance scores may be slightly subjective. For a more direct comparison, it may be beneficial to directly compare responses to individual items from NY farmers included in this study with the UK sample collected by Spence and colleagues (2012). Among NY farmers included in this study, the overwhelming majority -- nearly 70% -- of respondents agreed that climate change was likely to have a big impact on people similar to themselves, and over half (51%) of the respondents did not agree that developing countries would be disproportionately impacted by climate change; another quarter was uncertain about the idea. When Spence and colleagues (2012) asked the same questions in the UK, they found that approximately 45% of the population felt that people similar to themselves were likely to be impacted by climate change, and 36% of people disagreed that climate change would disproportionately impact developing countries. While it should be noted that neither of these statements specified whether the impacts would be positive or negative, the responses of NY farmers included in this study differ considerably from what other studies have found and suggest that climate change may be socially proximal to farmers in NY.

Temporal distance to climate change Overall respondents viewed climate change as a temporally proximal event. Seventy-one percent of respondents reported that the effects of climate change were already being felt in NY State. These results suggest a considerably more proximal interpretation of climate change compared to several other studies. For instance,

Leiserowitz and colleagues (2009) found that in general only 34% of Americans felt that people within the U.S. are currently being *harmed* by climate change. Although the current study did not specify harmful impacts - which may increase respondents' temporal distance as severe impacts are often viewed more distantly - the results still suggest a proximal temporal perception of the impacts of climate change. When a nearly identical question was asked in the UK (*When do you think the UK will start feeling the effects of climate change?),* Spence and colleagues (2012) found that only 45% of people within the UK believed that climate impacts were already being felt. It is important to note that the sample size of Leiserowitz et al. (2009) and Spence et al. (2012) were an order of magnitude larger than this current study, and that the impacts of climate change are not evenly distributed across the U.S. and the U.K. However, even with those considerations in mind, the difference in responses between farmers included in this study, the broader American public in Leiserowitz et al. (2009), and the UK public included in Spence et al. (2012) is substantial. One possible explanation for this difference in awareness to the temporal effects of climate change could be farmers' intimate relationship to weather patterns. As even seemingly insignificant yearly fluctuations in weather patterns can have immediate impacts on their lives, farmers are arguably more conscious of variability within weather patterns.

Spatial distance to climate change. Spatial distance to climate change results closely mirrored the results of social distance to climate change. However, as geographically distant areas tend to differ socially, it is perhaps unsurprising that the results from these two dimensions are so similar. Respondents again scored below the midpoint of the 9 – point spatial distance scale, suggesting that they tended to view climate change as a spatially proximal phenomenon. Furthermore, nearly 70% of respondents agreed that their local area was likely to be impacted by

climate change, and over half (56%) of respondents disagreed that climate change will disproportionately impact distant areas. As mentioned when discussing social distance, this differs from the idea that people tend to view the impacts of climate change only affecting geographically distant areas.

When we compare these results to what Spence and colleagues (2012) found within the British population, our data suggest a similar, yet more exaggerated, pattern to perceptions spatial distance perceptions in the UK. When asked the same questions, roughly half of people within the U.K. felt that their local area would be impacted by climate change and slightly less than half (48.6%) felt that climate change would disproportionately impact distant areas. However, even though there are quite a few commonalities between the climates of New York State and the United Kingdom, the regions themselves *are* spatially distant. When farmers in the Midwestern U.S. were asked if their farm operation would likely be harmed by climate change, only 22% agreed that it would (Arbuckle et al., 2015). Moreover, only 29% farmers in Yolo county California (although perhaps equally as spatially distant to NY as the UK) agreed that climate change poses more risks than benefits to agriculture (Niles et al., 2013). It is unclear why NY farmers included in this study had such a heightened perception of their local area being impacted by climate change.

Hypothetical distance to climate change. Overall, NY farmers included in this study seemed to accept the reality of climate change. Nearly 60% of respondents seemed certain that climate change is happening. However, most respondents (52%) perceived that the impacts of climate change are still uncertain. Although this study framed the question regarding climate change certainty slightly differently, the results seem to parallel what other studies have found. Multiple studies suggest that 60% – 70% of the U.S. population accept that climate change is

happening (Howe et al., 2015; Leiserowitz, Maibach, & Roser-Renouf, 2009). When focusing specifically on farmers: 66% of Midwestern farmers (Arbuckle, Prokopy, et al., 2013); 61% of Nevada ranchers (Liu, Smith, & Safi, 2014); and 54% of farmers in Yolo county California (Niles et al., 2013) perceive climate change to be occurring. Even though each of these studies framed the question differently, the resulting pattern – that the majority of both farmers and the broader American public accept the reality of climate change - is apparent.

One key aspect of how people frame climate change is their skepticism surrounding anthropogenic attribution. Among respondents in this study, the most common response was that climate change is caused by a combination of natural and human processes (54%). Approximately 25% of respondents felt that climate change was mostly or entirely due to human activity. Interestingly, even though respondents' certainty of climate change seemed to parallel the national average, the results of perceived anthropogenic climate change are considerably higher than what other studies suggest. Nationally, approximately 48% of Americans attribute current climate change (at least partially) to human activity (Leiserowitz, Maibach, & Roser-Renouf, 2009). However, when focusing specifically on farmers, this number is significantly lower. In the Midwestern U.S., only 41% of farmers agree that human activity is impacting climate change (Arbuckle, Prokopy, et al., 2013); in Yolo county California, 35% (Niles et al., 2013); and among rural Nevada farmers, 29% agree that human activity is affecting climate change (Liu et al., 2014). This variability could partially be explained by the framing of the question, as each of these aforementioned studies framed the question regarding the effects of human activity on climate change slightly differently. Indeed, NY farmers' perceptions of anthropogenic climate change appear to be more consistent with results found by Spence and colleagues (2012), who asked the same question in the UK. Spence and colleagues (2012) found

that 47% of people within the UK felt that climate change was a result of natural and human processes and 31% felt that it is mostly or entirely due to human activity.

Another key component in shaping an individual's attitude toward climate change is their perception of what experts think. Nationally, only 41% of people believe that there is a strong scientific consensus on anthropogenic climate change (Leiserowitz, Maibach, & Roser-Renouf, 2010). This study found that over 60% of participating NY farmers agreed (either "strongly" or "tend[ed] to") with the statement: "most scientists agree that humans are causing climate change" – substantially higher than the national average. Moreover, only 15% of participating NY farmers were dismissive of the idea that there is a consensus about anthropogenic climate change among scientists, which is substantially lower than the 34% of people nationally who believe there is a lot of disagreement among scientists (Leiserowitz et al., 2010).

What level of concern do NY farmers express for certain projected climatic impacts?

Overall, respondents indicated a moderate level of concern for impacts associated with climate change. Participating farmers reported the highest levels of concern for increasing energy and fuel prices. This item, along with "increased emission guidelines" intended to capture potential institutional responses to climate change that could directly influence farmers. Although these are not direct results of climate change, it is perhaps unsurprising that respondents stated significant concern as increasing energy costs present a challenge that directly impact the viability of a farming operation as well as one that many individuals have likely struggled with in the past.

The four *physical* impacts (increased heat stress, flooding, drought, and increased severe weather) of climate change included in this study garnered similar levels of concern among respondents. "More frequent or extreme weather events" received the highest rate of "very

concerned" responses, which is interesting as New York State has experienced a series of significant weather related catastrophes in recent years which have negatively impacted agriculture in certain regions of the state (e.g. Hurricane Sandy, Tropical Storms Irene and Lee). These results differ slightly from the levels of concern expressed by farmers in the Midwestern U.S. Arbuckle and colleagues (2013) found that overall, Midwestern farmers tended to be most concerned about drought and increased heat stress on crops (59% and 52% respectively). However, this difference is likely due to geographic variability in weather patterns and agricultural practices.

Interestingly, respondents tended to express greater levels of concern for a specific impact if they had already experienced that impact (i.e., drought, extreme weather, heat stress, and flooding). For example, respondents who stated they had experienced drought in the past were significantly more concerned about drought in the future. This seems to support an idea suggested in some literature that framing climate change through a more proximal lens (i.e. a single storm) may be beneficial in motivating people to take action as it relates the phenomenon and may make it less abstract. However, the link between individuals' concern and their willingness to take action is not always clear. Framing climate change through local flooding events is discussed in greater detail in a following section.

How much are NY farmers willing to pay for climate mitigation programs?

The majority of participants in this study were either uncertain (37%) about how much they would be willing to pay to mitigate climate change, or were unwilling to pay anything (30%). This is perhaps surprising given that the majority of participants recognized that climate change is happening, many of them accepting that human activity is at least partially responsible, and a significant number expressed concern over the projected impacts. There are a few ways to

interpret these results: (1) people don't recognize or are unaware of the benefits of mitigation; (2) people recognize the importance of mitigation, but don't perceive it having a positive impact (either on themselves or others); (3) people recognize the importance and efficacy of mitigation, but are unwilling the pay for it. Although education was the only demographic variable that significantly predicted respondents' WTP, there was a significant association between respondents' psychological distance and prior flood experience with their WTP for climate mitigation. The specific relationship between these variables will be discussed below.

How are the four dimensions of psychological distance, climate impact concern, and WTP, related to one another?

As discussed, psychological distance to climate change is likely not a uni-dimensional construct. Construal level theory suggests that the four dimensions of psychological distance are closely associated with one another, and that manipulating one dimension can influence the other three (Trope & Liberman, 2010). Results from this study support the idea that there exists a relatively strong positive correlation between the four dimensions of psychological distance, but this study did not explore the effect of manipulating one dimension of psychological distance (i.e. social, temporal, spatial, hypothetical) on the remaining three dimensions of psychological distance (e.g. measuring psychological distance dimensions pre and post reading of a primer intended to alter an individual's temporal distance to climate change). Given the significant correlation between the four dimensions, Spence and colleagues (2012) suggest that it may be beneficial to combine the four dimensions into a single overarching concept of psychological distance. Although this may indeed be beneficial for some analyses, it seems doing so detracts from understanding of how psychological distance to climate change relates to concern for climate change and willingness to pay (or to take action) for climate mitigation efforts. This

study found that while all four dimensions are fairly evenly correlated with one another, individuals' WTP for climate mitigation varied considerably across the four dimensions. In a regression of respondents' WTP against psychological distance dimensions, only social and hypothetical distance significantly related to respondents' WTP. The directionality of both of these associations suggests that individuals who view climate change as more socially or hypothetically distant are indeed, less willing to pay for climate mitigation. Furthermore, one may expect that respondents who are more concerned about climate change are more willing to pay for mitigation. Interestingly, results from this study show that concern for climate change was a poor predictor of WTP for mitigation efforts.

There is a more consistent association between psychological distance dimensions and expressed concern for climate impacts. Although individuals' concern for climate impacts were positively correlated with all dimensions of psychological distance, there was a range in the strength of correlation. Specifically, a regression of climate impact concern against each psychological distance dimension found that only social, temporal, and hypothetical distances were significantly related to respondents' concern for climate change impacts. However, it is perhaps unsurprising that people who view climate change as more temporally, socially, or hypothetically proximal also reported higher levels of concern for climatic impacts.

Does previous flooding experience relate to farmers' psychological distance or WTP?

As discussed, climate change is an abstract phenomenon that is largely imperceptible to humans. As such, many individuals have a difficult time understanding climate change, let alone relating to it. Although the physical relationship between global climate change and localized events (such as flooding) is fairly tenuous at best (climate change is really a statistical construct), there is evidence suggesting that experiencing such an event can influence an individual's

perception of climate change and potentially motivate them to take action. Previous studies have suggested that one potential reason people are hesitant to take action against climate change is that they lack "first-hand experience" of the impacts, and postulate that individuals who have experienced flooding events are more concerned about climate change impacts and more motivated to take action (Spence et al., 2011)

The current study found evidence that supports the notion that 'experiencing' climate change can potentially lead to increased awareness and willingness to take action. Sixty-one percent of people included in this study stated they had experienced flooding in the past 5 years, however it should be noted that "flooding" was not specifically defined. Overall, prior experience with flooding predicted lower levels of psychological distance, an increased WTP for climate mitigation (among respondents certain they would pay something), and increased concern for the physical impacts of climate change. However, when looking at the association between flooding and each distinct dimension of psychological distance, we see flooding experience was only significantly related to hypothetical distance. Individuals who had experienced flooding were more certain that climate change is happening, more convinced about the certainty of potential effects, more likely to perceive a scientific consensus, and less likely to perceive climate change as being exaggerated. Consequently, this decreased hypothetical distance related significantly to an increased level of concern and an increased willingness to pay more (or more appropriately willingness to pay something) for climate mitigation.

Limitations of this study

There are several key limitations in this study that should be considered. It is important to emphasize that as this study is based on a cross-sectional survey, no causal conclusions can be drawn from the results. Causality aside, the most apparent limitation comes from the relatively

small sample size considering the amount of farmers in NYS – roughly 36,000. Certain respondent demographics aligned well with broader NYS agriculture demographics. Participating farmers' age was in line with the average age of farmers in NY and the most heavily represented commodity was dairy – also in line with NY agriculture. However, a disproportionate amount of women responded to this survey (roughly half of respondents were female, while only about 20% of NY farmers are female) and other information (e.g. educational attainment, farm age) was unavailable. As such, there exist salient threats to external validity and results from this study may not be generalizable to the broader NY agricultural community. Furthermore, although the survey was conducted at an event that attracts farmers from all over the state, it is unlikely that all regions of the state were equally represented. As such, it may be inappropriate to generalize results from this study to the broader NY agricultural community. Further affecting external validity, it is important to consider that the distribution points of the survey were the Cornell Institute for Climate Change and Agriculture (CICCA) and the North East Organic Farming Association of New York (NOFA-NY). Both of these organizations likely hold similar views of the relationship between climate change and agriculture, and furthermore may attract an inherently biased type of person to their exhibits, potentially limiting the true randomness of the sample utilized. If future studies are interested in the climate change perceptions of farmers in NY, it would likely be beneficial to extend the sample size and sampling locations through utilizing a more diverse range of distribution points and sampling mechanisms.

It is also important to consider the sample size utilized in this study, and the consequences for statistical validity. Although the farm demographics captured in this study seem to mirror statewide agricultural statistics fairly closely, this study utilized a relatively small

sample size (N=110), which could lead to weak statistical power threatening statistical validity. Furthermore, many of the analyses conducted in this study divide the overall sample into smaller subgroups, further threatening statistical validity. When appropriate, the number of people included in each subgroup was reported.

When considering potential threats to internal validity, a few elements should be discussed. As this survey was conducted in August of 2015, history could be a potential threat to internal validity. Studies have shown a correlation between outside temperature and individuals' perception of climate change, with individuals exhibiting higher beliefs in climate change during times throughout the year (Zaval, Keenan, Johnson, & Weber, 2014). Furthermore, the Northeastern U.S. received 173% of its normal precipitation in June 2015, making it the second wettest June on record for NY (National Overview, 2015). If participants in this study were affected, or knew someone who was affected, by this above average precipitation (e.g. through flooded fields or stunted crop growth), it could have influenced their perception of climate change. For future work, it may be interesting to gather farmers' perspectives on climate change at different times in the year. For example, after planting, mid-summer, post-harvest, and mid-winter.

There are also salient threats to the construct validity of this study. Primarily, multiple dimensions of the psychological distance construct (social and spatial distance) were measured through a two item scale with rather low reliability as indicated by internal consistencies (Cronbach $\alpha = .008$ & Cronbach $\alpha = .072$ respectively). Although these dimensions have low internal consistencies, it was proposed that each individual item within the social and spatial distance scales deals with a different *aspect* of the psychological distance dimension and therefore both items were elected to remain in the measure. Furthermore, the construct validity

of this study could suffer from mono-method bias. All data were collected through a single self-report survey, rather than using multiple measurement types. Moreover, although the survey was self-administered and completely anonymous, an observer was present while respondents completed the survey. This could have led to respondents altering their answers due to *researcher expectancies* if they perceived the researcher to *desire* a particular answer.

Implications: Promoting climate action

Effectively communicating climate change can be challenging due to the relative complexity and imperceptibility of the issue. Multiple studies have suggested that through reducing climate change from a global to a local issue, people may be more willing to engage in action. For instance, Spence et al. (2012) argue that in order to increase action and concern for climate change, communication efforts should focus on decreasing the psychological distance of climate change through relating it to individuals' lives. However, others have suggested that reducing the psychological distance of climate change may actually decrease individuals' willingness to act. Brügger, Dessai, Devine-Wright, Morton, & Pidgeon (2015) argue that through reframing climate change from a global to a local perspective, people also shift the way they view the costs and benefits of taking action. As such, while any action to mitigate climate change will have some cost (e.g. monetary or physical effort), there are rarely if ever immediately realized localized benefits. Contrarily, by viewing climate mitigation on a global level, individuals are able to derive more abstract benefits from their actions.

Results from this study may have implications for both climate change communication as well as promoting engagement and action. Results support findings in Spence et al. (2012) and suggest that lower levels of psychological distance to climate change relate to increased levels of concern and increased levels of WTP for climate change mitigation programs. However, it

should be noted that social distance and hypothetical distance appeared to be the best predictors of individuals' concern and WTP. Framing climate change communication in such a way that reduces these two dimensions of psychological distance specifically, may be an effective way to increase awareness and encourage action. For instance, one of the largest discrepancies that arose in this study was the difference between respondents' perception of a scientific consensus on anthropogenic climate change, and the actual scientific consensus on this topic. As perception can be tailored by what individuals believe experts think (Lewandowsky, Gignac, & Vaughan, 2012), improved communication on the reality of this consensus may work to increase awareness and promote action.

Results from this study additionally suggest that there is a relationship between experiencing extreme weather events and increased levels of concern, and in the case of flooding, WTP for mitigation, and psychological distance. It is again important to note that *climate change* is a statistical construct, meaning no single weather event is truly attributable to it. However, these results support an idea presented by multiple studies that experiencing extreme weather can lead to increased risk perception, higher levels of concern for climate impacts, higher feelings of self-efficacy, and a greater willingness to reduce energy use (Taylor, De Bruin, & Dessai, 2014; van der Linden, 2014). If this relationship is accurate, it may be beneficial to utilize extreme weather events when communicating climate change, however, a few considerations should be made when considering this approach. It is fairly clear that individuals do not respond to catastrophic imaging associated with climate change, and that communicating through this approach can actually work to disengage people (O'Neill & Nicholson-Cole, 2009). A more effective approach may be to frame communication and imagery through localized and relatable events (e.g. a flooded field instead of flooded

Manhattan). Furthermore, as pointed out in Brügger et al. (2015), the relationship between experiencing extreme weather and climate change perception needs to account for how people *interpret* these weather events. That is to say, experiencing an extreme weather event may indeed increase an individual's awareness of climate change if they personally attribute the event to climate change, but may have no effect on their perception of climate change otherwise. Indeed, multiple studies have shown that experiencing extreme weather does not necessarily lead to increased concern and willingness to engage in climate mitigation (Whitmarsh, 2008).

Future research

This study builds upon existing perception studies, and perhaps unsurprisingly, finds significant commonalties between how NY farmers included in this study view climate change compared to farmers in other regions, the broader U.S. population, and an international sample. Through interpreting the results of participating NY farmers' attitudes and beliefs of climate change, a few areas of future research become apparent.

Some studies have suggested a strong interaction between educational attainment and political party affiliation on climate change perception; with increased education leading to heightened acceptance of climate change among Democrats and a decreased acceptance of climate change among Republicans (Hamilton, 2011). Unfortunately, this study did not capture political affiliations, so it did not provide insight as to whether this education by political party interaction exists among farmers. Although farming tends to be a more politically conservative profession, results from this study suggest that farmers throughout NY accept the reality of climate change and are concerned about potential impacts. Future farmer perception studies may empirically test this association by capturing farmers' political affiliations along with their perceptions of climate change.

Agriculture presents a variety of ways to significantly mitigate GHG emissions through altering practices or behavior, many of which can be immediately beneficial to the individual farmer as well. This study explored participating farmers' WTP for a national climate mitigation program (which has little immediate benefit for an individual farmer), but did not explore their willingness to adopt more sustainable practices on their farms. Potential follow up studies could investigate how willing farmers are to change their practices in ways that both mitigate GHG emissions and either increase the profitability of their farms (e.g. through increased yields) or save them money (e.g. through reduced fertilizer application).

Finally, most climate change perception studies explore similar constructs (i.e. acceptance of reality of climate change, perceived anthropogenic attribution of climate change, concern for impacts, etc.), yet few of them utilize similarly worded questions. For instance, this study found a substantial difference between participating NY famers' perceptions of anthropogenic climate change compared to what several other studies have found, yet every study framed the question slightly different. To better understand if this divergence in skepticism of anthropogenic climate change between farmers in NY and those in other regions of the country is attributable to actual differences in perception, future studies may benefit from a more universal framing of questions regarding anthropogenic contribution to climate change, and other climate change perception constructs. Furthermore, there appear to be significant differences in farmers' perceptions of climate change compared to the broader general public. However, there is also evidence that suggests climate change perceptions vary significantly across the U.S. (Howe et al., 2015). To better understand how (if at all) farmers' climate change perceptions vary compared the general public, future studies could focus on regional differences between the two groups (i.e. farmers compared to non-farmers).

Conclusion

Agriculture is an important component of New York State's economy and culture. Present and future climate change will likely bring new and unique challenges and opportunities to agriculture throughout the state by altering existing temperature and precipitation patterns. Many agricultural systems have the potential to address the challenges associated with climate change while capitalizing on the opportunities through appropriate adaptation and mitigation. Multiple regional, statewide, and national programs have focused on improving agricultural adaptation and mitigation, however the success of any program depends upon the support of the individuals it targets. As such, the success of current and future agricultural adaptation and mitigation programs depends upon farmers' attitudes, beliefs, and concerns surrounding climate change. Furthermore, as farmers have substantial experience in preparing for and dealing with weather-related challenges, they are arguably more conscious of fluctuations in weather patterns and likely offer unique perspectives regarding climate change.

This study aimed to capture the psychological distance of climate change in the minds of farmers throughout New York State along with their perceived concern for potential climate impacts and willingness to pay for a national mitigation program. It was hoped that a better understanding individuals' specific attitudes and beliefs surrounding climate change could lead to improved communication and outreach efforts and consequently improved adaptation and mitigation programs more regionally tailored to farmers' needs. To capture farmers' attitudes and beliefs, a cross sectional survey gathered a convenience sample of farmers attending a large agricultural trade show in the summer of 2015 in central New York State (N=110).

Farmers participating in this study tended to view climate change as a psychologically proximal event. Their certainty about the reality and anthropogenic contribution of climate

change mirrored or surpassed that of most nationally representative samples as well as other agricultural stakeholder climate change perception studies. The majority of respondents tended to view climate change as both spatially and socially proximal. That is, they perceived New York State and people *similar to themselves* likely to be affected by the impacts of climate change. Moreover, most respondents perceived climate change as a phenomenon a*lready* being felt across New York, suggesting a more temporally proximal interpretation of the impacts associated with climate change compared to other studies. Overall, there are significant similarities between this study and what other studies have suggested to be nationally representative when it comes to climate change perception. However, respondents in this study seemed to view climate change as: more likely to be attributable to human activity, more likely to influence people similar to themselves, with a greater agreement on the reality of a scientific consensus, and more temporally proximal. Results from this study are compared with the aforementioned farmer perception studies in Table 10. It is important to note that each study included framed questions slightly differently, which could have had a substantial impact on how an individual interprets the question. Future studies may benefit by establishing commonly phrased questions, allowing for the direct comparison across samples. Although more work is needed, results from this study – and others - suggest that there may be distinct differences between how farmers view climate change compared to the broader public.

Table 10: Survey results comparison across studies by question focus [3]

Survey Topic	NY	Midwest	Iowa	Nevada Ranchers	American Public
CC is Occurring	58%	66%	-	60%	70%
Anthropogenic	78%	8%	45%	29%	53%
Exaggerated	34%	-	66%	-	42%
Scientific consensus	59%	-	-	-	53%
Affect local people	68%	-	33%	-	59%

[3] Data from Arbuckle, Prokopy, and colleagues (2013) for Midwest; Arbuckle, Morton, and colleagues (2013) for Iowa; Liu and colleagues (2014) for Nevada; and Leiserowitz and colleagues (2013) for the American public.

Respondents in this study also appeared to exhibit moderate levels of concern for impacts associated with climate change. Interestingly, the impacts that received the highest levels of concern were not physical impacts, but institutional changes (increased energy process and regulation) that could arise as a result of climate change (among other things). Considering most respondents viewed climate change as both spatially and temporally proximal, this could reflect the idea that farmers are experienced in dealing with weather related events and feel confident in their ability to handle them in the future. Farmers recorded concern for the physical impacts included in this study seem to mirror significant weather events experienced in New York State, further supporting the idea that farmers' (and possibly individuals') concern for climate impacts is associated with their past extreme weather experience.

In addition, this study aimed to explore the idea that prior exposure to flooding could influence individuals' perceptions of climate change, their willingness to engage in sustainable behavior, and their overall concern for climate impacts. Of the farmers included in this study, prior flooding experience was significantly associated with individual's hypothetical distance (or their certainty surrounding the reality) of climate change. Respondents who had experienced flooding in the past were more likely to be certain that climate change is happening, to perceive a scientific consensus on anthropogenic climate change, and less likely to view climate change as being exaggerated. The results of this study should be useful in the development and improvement of communication and outreach initiatives that aim to meet the challenges associated with climate change and agriculture.

Cornell University

Climate Risk Perceptions of New York State Farmers

Background: This study is being carried out by Trevor Partridge as a Master's thesis for the Horticulture Department of Cornell University. The intention of this study is to capture the risks, beliefs, and attitudes of New York State farmers concerning climate change and the environmental impacts associated with it. Through understanding your opinions, I am hoping that we can work to establish more effective outreach programs and ultimately strengthen Agriculture in New York State. Completion of this survey is totally voluntary and shouldn't take longer than 5 minutes to complete. No name or contact information is required and all results are anonymous.

Directions: This survey consists of 5 brief sections. It should not take longer than 5 minutes to complete. Please answer the questions truthfully and in entirety. Completed surveys can be handed back to the person distributing them as soon as they are complete. Any questions regarding the survey or project can be directed at Trevor Partridge at **315 558 2815** or by email at **tfp23@cornell.edu.** The survey begins on the following page.

Your assistance in this project is greatly appreciated. Results of this survey will be shared with any interested party.

Trevor Partridge
Cornell University
(315) 558-2815
Email: tfp23@cornell.edu

Part A – Severe Weather Experience.

The following questions ask you about your previous experience with flooding. Please check Yes, No, or Don't know.

	Yes	No	Don't Know
Have you personally experienced flooding in your local area in the last 5 years?			

Part B – Climate Change Beliefs

The following questions are about your opinions regarding climate change. Please indicate whether you agree or disagree with the following statements based on the scales below

	Strongly Agree	Tend to Agree	Uncertain	Tend to Disagree	Strongly Disagree
My local area is likely to be affected by climate change	1	2	3	4	5
Climate change will mostly affect areas that are far away from here	1	2	3	4	5
The seriousness of climate change is exaggerated	1	2	3	4	5
Climate change is likely to have a big impact on people like me	1	2	3	4	5
Most scientists agree that humans are causing climate change	1	2	3	4	5
Climate change will mostly affect developing countries	1	2	3	4	5
I am uncertain that climate change is really happening	1	2	3	4	5
It is uncertain what the effects of climate change will be	1	2	3	4	5

Which of the followings phrases best describes your opinion when completing the sentence;
Climate change is _____.

- ☐ entirely caused by natural processes
- ☐ mainly caused by natural processes
- ☐ partly caused by natural processes and partly caused by human activity
- ☐ mainly caused by human activity
- ☐ entirely caused by human activity
- ☐ I don't think there is such a thing as climate change

Part C – Climate Change Risks

*The following question asks if you have experienced certain events as well as your level of concern about certain agricultural risks associated with climate change. Please circle your level of concern for the following potential impacts of climate change **AND** whether or not you have already experienced them.*

	Not Concerned	Slightly Concerned	Concerned	Very Concerned	Have you experienced:		
Longer dry periods and drought	1	2	3	4	Yes	No	Don't know
Increased heat stress	1	2	3	4	Yes	No	Don't know
More frequent or extreme weather events	1	2	3	4	Yes	No	Don't know
Increases ponding water and flooding	1	2	3	4	Yes	No	Don't know
Increased emission guidelines	1	2	3	4	Yes	No	Don't know
Higher fuel and energy prices	1	2	3	4	Yes	No	Don't know

When, if at all, do you think New York will start feeling the effects of climate change?

☐ We are already feeling the effects ☐ In the next 25 years ☐ In the next 100 years ☐ Never

☐ In the next 10 years ☐ In the next 50 years ☐ Beyond 100 years

Part D – Willingness to pay for climate change mitigation

The next question asks you to select how much you would be willing to pay for climate change mitigation. Congress is considering a mitigation policy that would reduce U.S. greenhouse gas emissions 17% by 2025. This policy would increase the cost of living for all American households. In support of this policy, what is the maximum amount your household would be willing to pay each year for the next 10 years? (Select one answer)

☐ $0 ☐ $60 ☐ $157 ☐ $250 ☐ Don't know

☐ $26 ☐ $121 ☐ $193 ☐ $475 or more

Part E – About you

Lastly, please tell us about yourself and your farm. For each question please check the box that best describes you.

	Less than 25years	25-34	35-44	45-54	55-64	65 – 74	75 years and over
What is your Age?							

What is your gender? ☐ Male ☐ Female

What is the highest level of education you have completed?

☐ Did not complete high school ☐ Some College, no degree ☐ Bachelor's Degree

☐ completed high school ☐ associates or technical degree ☐ Graduate Degree

What is your relationship to the farm?

☐ Farm owner / co-owner ☐ Part time employee ☐ None of the above

☐ Full time employee ☐ Spouse to owner

What type of farm do you have? (Check all that apply)**:**

☐ Dairy ☐ Grain ☐ Beef ☐ Vegetables

☐ Poultry ☐ Orchard ☐ Organic ☐ Other:_____

How long has the farm you are affiliated with been in operation?

☐ Less than 5 years ☐ 5-10 years ☐ 11 to 20 years ☐ 21 to 50

☐ More than 50 years

How would you describe the size of your farm?

☐ Hobby ☐ Small ☐ Medium ☐ Large

Please estimate your yearly household income to the nearest $5,000. _____

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